Institut de Recherches pour les Huiles et Oléagineux

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GHANA OIL PALM DEVELOPMENT CORPORATION
G.O.P.D.C.
Kwae Plantation
Mission from 13th to 21st June 1990

Part one - Mineral Nutrition and Clones

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CONTENTS

SUMMARY - CONCLUSION

Reasons beyond our control prevented us writing up this report on our June 1990 visit sooner.

In order to avoid repetition in the report on our November 1990 mission, which is currently being written, we shall only discuss mineral nutrition, clones and Phase II (nursery, planting), leaving the following aspects for the November report: planting, production, production costs and budget, marketing and training.

As regards mineral nutrition, it was decided, at the request of the IDA supervisory mission, not to apply fertilizers in 1990 (except on young plantings). The 1989 LA results show an almost universal imbalance, across NES, SH and OG, of phosphate nutrition in relation to nitrogen nutrition, leading to a P deficiency which has to be corrected by fertilizer applications, a K deficiency of varying severity on TKO series soils and satisfactory nutrition in terms of the other elements (N, Ca, Mg and Cl). The results of the trials show that TSP applications increase production on Nzima, although they do not significantly improve the N/P imbalance, whereas on Temang, the imbalance is improved but there is no impact on production. In addition, potassium nutrition on Nzima is satisfactory, whereas despite higher KCl rates, it is deficient on Temang, and rates have no effect - at present - on production. In conclusion, KCl fertilizer rates can be reduced on NB series soils and maintained at higher levels on TKO, as a precautionary measure. TSP or RP rates should be increased on both NB and TKO.

Schedules were drawn up and recommendations made for the NES based on these data. They will be revised in accordance with the 1990 LA results, but could be used as a basis for 1991, particularly for fertilizer orders. They correspond to an average rate of 1.8 kg per tree.

In addition, since a large proportion of the fertilizers distributed to the OG are not applied, Mr. Carlier requested that distribution be limited to the first planting year, with subsequent supplies being on a cash-only basis. Similarly, LAs will only be carried out every other year.

The 1988 clones are developing well and are precocious. The most noteworthy at present is LMC 043, with 7.7 bunches/tree on average. Harvesting is due to begin in January 1991. The 1989 planting (1.8 ha) has suffered a few losses, due to grasscutters. The 1990 plantings were set up from 7th to 15th May; the plantings cover 13.5 ha and include 9 clones and a control produced from seed. Tree development is good, but certain zones will have to drained more effectively.

785 ha were planted in 1990 under Phase II, split between 702 ha of new farms, 23 ha of extensions and the equivalent of 60 ha of replacements. A total of 3,750 ha will have been set up by outgrowers between 1986 and 1990.

The comparative trial (IRHO and OPRI planting material shows a very high mortality rate (grasscutters, rodents, but above all drought); the OPRI material is more severely affected (59%) than the IRHO material (35%). There are doubts as to whether it is worth continuing this trial.

I. INTRODUCTION

This mission by Mr. Wuidart, Director of the IRHO Oil Palm Division, took place from 13th to 21st June 1990, in accordance with the terms of the GOPDC/IRHO/IBRD contract. This visit followed on from the one in February (Doc. 2278 bis), and its aims were:

1. General inspection of Phases I and II
2. Mineral nutrition and fertilizer recommendations
3. Clones
4. 1990 Phase II planting and nursery
5. Drawing up a simple record sheet for monitoring production costs
6. Palm oil marketing
7. Training.

As explained in the "Summary-Conclusion", it was not possible to produce this report earlier, and to avoid repetition in the report on our November visit, only points 2, 3 and 4 will be considered here, including the results obtained, observations made and decisions taken during the two visits.

Under the Phase II extension in 1991 and 1992, which will be followed in 1993 by Phase III, we met Mr. Maamah (Ministry of Finance) and Dr. Dapah (Ministry of Agriculture). We should like to thank them for the time they spent with us.

We are also grateful to the whole of the GOPDC team (Accra and Kwae) for the excellent welcome we received and for the help they gave us throughout the visit.

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II. MINERAL NUTRITION

II.1. FERTILIZER TRIALS

These trials are GH CP 1, set up on Nzima type soils and GH CP 2, on Temang. The two series can be summarized as follows:

Nzima = high slopes - laterite
Temang = foot slopes - alluvial and colluvial - satisfactory drainage - temporary waterlogging.

The Nzima series, to which we added the Bekwai series (summit - skeletal soil - rock outcrops - eroded) covers 53% of the total area of the NES, whilst the Temang series plus Oda (valley bottom - permanent waterlogging) covers 31%. The remainder - 16% - corresponds to the Kokofu intermediate series (mid-slopes - well drained colluvial soil).

The different fertilizer applications for each treatment began in 1984 and were halted in 1986, to be resumed in 1987. Individual harvesting began in 1988. These two trials, along with the rest of the plantation, suffered very sever defoliation in 1987, due to a Coelaenomenodera minuta attack at the end of 1986. The adverse effects of this defoliation had repercussions on yields in 1987, 1988 and - to a lesser extent - 1989.

II.1.1. GH CP 1

Plot = CN2, Planting year = 1978, Series = Nzima

Design: 3 x 3 factorial studying 3 levels of N, P and K.

Until 1984, the plot received the same fertilizers as the rest of the plantation, and subsequently (in g per tree):

	AS			SSP then TSP*			KCl		
Treatment	0	1	2	0	1	2	0	1	2
Nov. 84	0	1000	2000	0	1000	2000	0	1000	2000
Feb. 85	0	0	0	0	1100	2200	0	500	1000
1986	0	0	0	0	0	0	0	0	0
July 87	0	0	0	0	500*	1000*	0	500	1000
July 88	0	0	0	0	1100*	2200*	0	500	1000
July 89	0	0	0	0	500*	1000*	0	500	1000

AS = Ammonium sulphate
SSP = Single super phosphate
TSP = Triple super phosphate
KCl = Muriate of potash

Annex I-1 gives the complete results (LA and production) and comments made by our Agronomy Division.

In brief:

- nitrogen nutrition, with no AS applications since 1985, is highly satisfactory
- SSP and TSP applications significantly improve phosphate nutrition, but does not correct the N/P imbalance, which is around 6% (observed P = 94% calculated P)
- potassium nutrition is still satisfactory, even for treatment K0
- calcium and magnesium nutrition are still above the critical levels
- chlorine nutrition is improved by KCl applications
- sulphur nutrition is not affected by the treatments, and is still satisfactory
- bunch production, which was severely affected in 1988 by the Coelaenomenodera attack - 7.3 tonnes FFB/hectare on average for the trial (8 tonnes for the best treatment) - reached 12.5 tonnes in 1989 (13.2 tonnes for the best treatment). Results show that the defoliation caused by Coelaenomenodera affected both bunch production components in 1988: number (-20%) and particularly mean weight (-30%), and that production figures are quite similar to those recorded for the 1978 NES plantings as a whole (including Temang series soils)

	BN	MBW	BW/tree kg	BW/ha t
1988 NES	5.0	11.2	56	7.6
GH CP 1	5.2	10.2	53	7.2
1989 NES	5.6	14.9	83	11.3
GH CP 1	6.5	14.3	93	12.5

In conclusion, only phosphate fertilizer had an effect on production, according to the 1989 results, under the conditions of the experiment, with an extra 10 kg of bunches per tree, i.e. 1.4 tonnes per hectare. A further year of observations, provided these are not affected by external factors, should confirm this first impression.

The following fertilizers were recommended for 1990, in g/tree:

Levels	KCl	TSP	AS
0	0	0	0
1	500	750	0
2	1000	1500	0

TSP rates for P1 and P2 were increased slightly compared with 1989: 750 g as opposed to 500, 1500 as opposed to 1000.

II.1.2. GH CP 2

Plot = AN1, Planting year = 1977, Series = Temang.

Design = 3 x 3 factorial studying 3 levels of N, P and K.

This plot received the same fertilizers as the plantation until 1984, and subsequently (in g per tree):

Treatment	AS 0	AS 1	AS 2	SSP or TSP* 0	SSP or TSP* 1	SSP or TSP* 2	KCl 0	KCl 1	KCl 2
Nov. 84	700	1500	3000	0	1200	2400	0	1300	2600
Feb. 85	0	0	0	0	1100	2200	0	1300	2600
1986	0	0	0	0	0	0	0	0	0
July 87	0	1000	2000	0	500*	1000*	0	2000	4000
July 88	0	0	0	0	500*	1000*	0	1500	3000
July 89	0	0	0	0	500*	1000*	0	1500	3000

Annex I-2 gives the complete results (LA and production) and comments made by our Agronomy Division.

In brief:

- nitrogen nutrition, with no AS applications since 1987, is still satisfactory
- SSP and then TSP applications significantly improve phosphate nutrition and enables rate P2 to come close to the optimum P content, calculated based on the N/P balance
- potassium nutrition is largely deficient and only partly corrected by KCl applications
- fertilizer has no effect on calcium nutrition, for which contents are satisfactory
- KCl applications significantly reduce magnesium contents, but they are still high (0.242% for the lowest rate)
- chlorine nutrition is good, and the KCl applied significantly increases Cl contents
- sulphur nutrition is not affected by the treatments, and is satisfactory
- mean bunch production, which was 9.2 tonnes of bunches per hectare in 1988, increased slightly to 10.3 tonnes in 1989, but is still lower than it should be on this type of soil, which is much better than the Nzima series, where GH CP 1 produced 12.5 tonnes. Lower production for the 77 plantings (Temang) compared with the 78 plantings is not specific to the trials and was

seen over the two plantings as a whole in 1989 (tonnes FFB/hectare/year):

Planting year	1982	1983	1984	1985	1986	1987	1988	1989
1977	8.4	4.6	7.4	7.0	13.2	7.7	10.0	10.8
1978	3.2	3.8	4.9	7.6	12.7	5.6	7.6	11.3

This seems to suggest that defoliation due to Coelaenomenodera had a less marked effect on the 1977 plantings than on the 1978 plantings in 1988 (10.0 tonnes FFB/hectare as opposed to 7.6), but staggered over time (10.3 tonnes as against 11.3 in 1989). It is interesting to compare the results for GH CP 2 with those for the 1977 planting as a whole, which were mainly planted on Temang: total production is similar, since the high MBW compensates for a lower NB.

	NB	MBW	BW/tree kg	BW/ha t
1988				
NES	4.9	15.0	74	10.0
GH CP 2	4.1	16.5	68	9.2
1989				
NES	4.6	17.5	80	10.8
GH CP 2	3.6	21.0	76	10.3

In conclusion, although phosphate applications correct the P deficiency and bring levels up close to the N/P balance, KCl applications do not correct the severe K deficiency which appears to be characteristic of these Temang series soils. For the time being, no treatment effect has been seen on production, and it would be useful to have at least another year's observations in order to draw more reliable conclusions.

It was recommended that 1989 fertilizer rates be continued in 1990, i.e. (in g per tree):

Levels	KCl	TSP	AS
0	0	0	0
1	1500	500	0
2	3000	1000	0

II.2. 1989 LA RESULTS AND FERTILIZERS APPLIED

The complete 1989 LA results are given in Annex I-3, as are the data for each NES LA unit for the past three years (1987 to 1989).

II.2.1. NES

Table I gives the LA results per planting year and per soil type for the years 1986 to 1989.

- Nitrogen nutrition

This is good for all the planting years, irrespective of soil type, and generally over the commonly accepted critical level of 2.4%.

TABLE I: NES LA RESULTS PER PLANTING YEAR AND SOIL TYPE

	Planting year	LA year	N	P	K	Ca	Mg	Cl
NB								
	1978	86	2.483	0.155	0.951	0.870	0.272	0.566
		87	2.720	0.160	0.980	0.817	0.253	0.571
		88	2.663	0.159	0.925	0.789	0.255	0.648
		89	2.680	0.156	0.932	0.793	0.285	0.682
	1979	86	2.428	0.152	0.968	0.932	0.340	0.643
		87	2.735	0.163	0.946	0.962	0.284	0.625
		88	2.676	0.156	0.940	0.887	0.273	0.658
		89	2.741	0.157	0.924	0.905	0.286	0.684
	1980	86	2.672	0.165	0.920	0.937	0.330	0.516
		87	2.673	0.166	0.942	1.013	0.306	0.537
		88	2.755	0.163	0.960	0.893	0.289	0.612
		89	2.840	0.161	1.004	0.878	0.293	0.616
	1981	86	2.527	0.156	1.051	1.001	0.324	0.502
		87	2.763	0.164	0.965	1.006	0.260	0.565
		88	2.678	0.156	0.871	0.993	0.267	0.590
		89	2.840	0.159	0.963	0.959	0.281	0.612
	1982	86	2.520	0.143	1.061	0.939	0.334	0.756
		87	2.730	0.163	1.005	0.873	0.334	0.765
		88	2.860	0.169	1.026	0.938	0.287	0.671
		89	3.020	0.162	0.997	0.842	0.282	0.642
	1985	88	2.870	0.167	0.869	1.025	0.280	0.781
		89	2.947	0.161	0.928	0.922	0.282	0.684
TKO	1977	86	2.430	0.153	0.821	0.855	0.257	0.611
		87	2.540	0.159	0.917	0.816	0.262	0.648
		88	2.480	0.157	0.843	0.718	0.288	0.732
		89	2.450	0.152	0.757	0.736	0.317	0.754
	1978	86	2.340	0.152	0.831	0.834	0.272	0.619
		87	2.614	0.162	0.842	0.875	0.270	0.607
		88	2.602	0.160	0.808	0.769	0.263	0.682
		89	2.647	0.161	0.777	0.760	0.271	0.735
	1979	86	2.558	0.160	0.906	0.896	0.301	0.603
		87	2.708	0.160	0.879	0.888	0.251	0.591
		88	2.646	0.156	0.847	0.813	0.279	0.659
		89	2.672	0.157	0.894	0.781	0.286	0.732
	1980	86	2.457	0.155	0.777	0.903	0.368	0.665
		87	2.605	0.159	0.939	0.893	0.326	0.600
		88	2.613	0.156	0.812	0.851	0.323	0.658
		89	2.730	0.157	0.876	0.857	0.340	0.702
	1981	86	2.540	0.158	0.796	0.958	0.393	0.675
		87	2.673	0.162	0.858	0.885	0.316	0.666
		88	2.740	0.164	0.803	0.877	0.305	0.667
		89	2.735	0.155	0.753	0.960	0.356	0.740
	1982	86	2.660	0.157	0.744	0.872	0.307	0.721
		87	2.650	0.158	0.698	0.957	0.334	0.693
		88	2.705	0.159	0.751	0.930	0.297	0.800
		89	2.790	0.153	0.737	0.865	0.288	0.755
	1985	88	2.630	0.162	0.763	1.033	0.301	0.789
		89	2.782	0.158	0.732	0.931	0.298	0.734

- Phosphate nutrition (Table II)

This is characterized by an imbalance - to varying extents - in relation to nitrogen nutrition, for all the plantings irrespective of soil type. Most of the plots have P contents within the range of the balance: - 0.01 to - 0.02%. This imbalance leads to a P deficiency which has to be corrected by fertilizer applications. Table II shows that in general, the fertilizers applied are markedly below recommendations, and that the imbalance has become even more marked over the years in most cases. Trial results (section II-1) show that in the case of GH CP 1 (Nzima series), although they did not improve the N/P imbalance significantly, TSP applications did lead to surplus production in 1989, whereas for GH CP 2 (Temang series), there was an improvement in the imbalance but there has not yet been any effect on production.

- Potassium nutrition (Table III)

Except for a few plots, K nutrition in plantings on NB series soils is satisfactory.

Their distribution in terms of K contents is as follows:

Planting Years	K ≥ 0.9	0.8 ≤ K < 0.9	0.7 ≤ K < 0.8	K < 0.7
1978	3	1		
1979	3	4		1
1980	6			
1981	5	1	1	
1982	1			
1985	2	1		

The deficient plots are BS6 (1978) = 0.651% and FN19 (1981) = 0.766%.

K contents for the plantings set up on the TKO series are always less than 0.9 on average, and are between 0.732 and 0.894, depending on the planting year. The lowest contents are seen in the following plots from the following plantings: 1978 (CS2 = 0.602%), 81 (GN19 = 0.577%), 82 (BS11 = 0.639%) and 85 (AS6 = 0.568%). KCl applications since 1987 have not generally improved the situation, confirming the observations made in GH CP 2 (section II-1) and leading to the conclusion that the high K deficiency is characteristic of these soils.

TABLE II: Comparison between P (LA) and calculated P (N/P ratio)

	Plant. year	LA year	N%	P%	P% (N/P ratio)	TSP fertilizer (g/tree)		
						Year	R	A
NB								
	1978	86	2.483	0.155	0.161 (96)	87	0	0
		87	2.720	0.160	0.172 (93)	88	1000	1000
		88	2.663	0.159	0.170 (94)	89	500	500
		89	2.680	0.156	0.170 (92)	90	0	0
	1979	86	2.428	0.152	0.158 (96)	87	0	0
		87	2.735	0.163	0.173 (94)	88	1000	0
		88	2.676	0.156	0.170 (92)	89	1000	1000
		89	2.741	0.157	0.170 (92)	90	0	0
	1980	86	2.672	0.165	0.170 (97)	87	0	0
		87	2.673	0.166	0.171 (97)	88	0	0
		88	2.755	0.163	0.174 (94)	89	750	750
		89	2.840	0.161	0.178 (90)	90	0	0
	1981	86	2.527	0.156	0.163 (96)	87	0	0
		87	2.763	0.164	0.174 (94)	88	1000	0
		88	2.678	0.156	0.170 (92)	89	1000	1000
		89	2.840	0.159	0.178 (89)	90	0	0
	1982	86	2.520	0.143	0.163 (88)	87	500	750
		87	2.730	0.163	0.173 (94)	88	1000	0
		88	2.860	0.169	0.179 (94)	88	500	500
		89	3.020	0.162	0.187 (87)	90	0	0
	1985	88	2.870	0.167	0.179 (93)	89	750	750
		89	2.947	0.161	0.183 (88)	90	200	800
TKO								
	1977	86	2.430	0.153	0.158 (97)	87	0	0
		87	2.540	0.159	0.164 (97)	88	0	0
		88	2.480	0.157	0.161 (98)	89	0	0
		89	2.450	0.152	0.159 (96)	90	0	0
	1978	86	2.340	0.152	0.154 (99)	87	0	0
		87	2.614	0.162	0.167 (97)	88	1000	1000
		88	2.602	0.160	0.167 (96)	89	500	500
		89	2.647	0.161	0.169 (95)	90	0	0
	1979	86	2.558	0.160	0.164 (98)	87	0	0
		87	2.708	0.160	0.172 (93)	88	1000	0
		88	2.646	0.156	0.169 (92)	89	1000	1000
		89	2.672	0.157	0.170 (92)	90	0	0
	1980	86	2.457	0.155	0.159 (97)	87	0	0
		87	2.605	0.159	0.167 (95)	88	0	0
		88	2.613	0.156	0.167 (93)	89	750	750
		89	2.720	0.157	0.172 (91)	90	0	0
	1981	86	2.540	0.158	0.164 (96)	87	0	0
		87	2.673	0.162	0.170 (95)	88	0	0
		88	2.740	0.164	0.173 (95)	89	500	500
		89	2.736	0.155	0.173 (90)	90	0	0
	1982	86	2.660	0.157	0.169 (93)	87	500	0
		87	2.650	0.158	0.169 (93)	88	1000	0
		88	2.705	0.159	0.172 (92)	89	1000	1000
		89	2.790	0.153	0.176 (87)	90	0	0
	1985	88	2.630	0.162	0.168 (96)	89	500	500
		89	2.782	0.158	0.175 (90)	90	800	800

R = Recommended
A = Applied

Table III: K contents (%) and fertilizers.

	Plant. Year	LA Year	K contents % Min	Mean	Max	KCl Fertilizers (g/tree) Year	B	A
NB	1978	86	-	0.951-		87	1500	1600
		87	0.939	0.980	1.044	88	2000	2000
		88	0.783	0.925	1.026	89	750	750
		89	0.651	0.932	1.160	90	1000	1000
	1979	86	-	0.968	-	87	1000	1500
		87	0.897	0.946	1.126	88	2000	2000
		88	0.868	0.940	1.024	89	500	500
		89	0.801	0.924	1.077	90	0	0
	1980	86	-	0.920	-	87	1000	1300
		87	0.818	0.942	1.059	88	2000	2000
		88	0.879	0.960	1.041	89	500	500
		89	0.941	1.004	1.062	90	0	0
	1981	86	-	1.051	-	87	1000	1300
		87	0.862	0.964	1.157	88	2000	2000
		88	0.770	0.871	1.042	89	750	750
		89	0.766	0.963	1.204	90	0	0
	1982	86	-	1.061	-	87	500	1000
		87	-	1.005	-	88	2000	2000
		88	-	1.026	-	89	500	500
		89	-	0.997	-	90	0	0
	1985	86	-	-	-	87	500	500
		87	-	-	-	88	1000	1000
		88	0.834	0.869	0.909	89	750	750
		89	0.821	0.928	0.996	90	1500	1500
TKO	1977	86	-	0.821	-	87	2000	2100
		87	0.806	0.917	1.046	88	2000	2000
		88	0.822	0.843	0.860	89	1500	1500
		89	0.715	0.757	0.788	90	2000*	2000*
	1978	86	-	0.831	-	87	3000	2400
		87	0.705	0.842	0.992	88	2500	2500
		88	0.723	0.808	0.902	89	2000	2000
		89	0.602	0.777	0.868	90	2000*	2000
	1979	86	-	0.906	-	87	2000	2100
		87	0.735	0.879	1.047	88	2000	2000
		88	0.661	0.847	0.912	89	1500	1500
		89	0.862	0.894	0.935	90	0	0
	1980	86	-	0.777	-	87	1500	1500
		87	0.677	0.939	1.299	88	2000	2000
		88	0.646	0.812	1.026	89	2000	2000
		89	0.792	0.876	1.023	90	0	0
	1981	86	-	0.796	-	87	2000	1300
		87	0.843	0.858	0.877	88	2000	2000
		88	0.725	0.803	0.909	89	1500	1500
		89	0.577	0.753	0.877	90	0	0
	1982	86	-	0.744	-	87	2000	1000
		87	-	0.698	-	88	2000	2000
		88	0.642	0.751	0.859	89	2500	2500
		89	0.639	0.737	0.835	90	2000	2000**
	1985	86	-	-	-	87	500	500
		87	-	-	-	88	1000	1000
		88	0.627	0.763	0.940	89	2500	2500
		89	0.568	0.732	0.927	90	1500	1500

* or 4000 g ash

** BS 11,12,13

Plot distribution according to K content is as follows:

Planting Years	$K \geq 0.9$	$0.8 \leq K < 0.9$	$0.7 \leq K < 0.8$	$K < 0.7$
1977			4	
1978		3	2	1
1979	3	3		
1980	2	4	1	2
1981		2		1
1982		1		2
1985	1		2	

It is worth remembering that plots cannot be split neatly between NB series (Nzima-Bekwai) and TKO series (Temang, Kokofu, Oda), and that some plots are intermediate NB, TKO. They were placed in one group or the other, depending on which type was dominant. This split is justified by the wish to simplify fertilizer recommendations (limiting schedules), hence applications, as much as possible.

In conclusion, KCl fertilization can be reduced in the NB blocks to keep them around the critical level of 0.9%. For the TKO plantings, there is not enough data from trial GH CP 2 to enable conclusions to be drawn, and it would be wise to keep KCl applications higher than on NB.

- Calcium nutrition (Table IV)

Table IV: Ca Contents (%)

Plant. Year	LA Year	Ca Contents (%) Min	Mean	Max	Ca Contents (%) Min	Mean	Max
	NB				TKO		
1977	87				0.773	0.816	0.873
	88				0.656	0.718	0.766
	89				0.674	0.736	0.819
1978	87	0.781	0.817	0.851	0.796	0.875	0.962
	88	0.675	0.789	0.882	0.723	0.769	0.807
	89	0.681	0.793	0.909	0.677	0.760	0.832
1979	87	0.870	0.962	1.082	0.815	0.888	0.944
	88	0.817	0.887	1.014	0.715	0.813	0.894
	89	0.773	0.905	1.103	0.691	0.781	0.952
1980	87	0.859	1.013	1.189	0.759	0.893	1.031
	88	0.827	0.893	0.952	0.753	0.851	0.962
	89	0.797	0.878	0.945	0.766	0.857	1.073
1981	87	0.837	1.006	1.129	0.784	0.885	0.939
	88	0.921	0.993	1.075	0.810	0.877	0.967
	89	0.903	0.959	1.026	0.850	0.960	1.089
1982	87	-	0.873	-	-	0.957	-
	88	-	0.938	-	0.870	0.930	0.989
	89	-	0.842	-	0.805	0.865	0.924
1985	88	0.932	1.025	1.102	0.625	1.033	1.107
	89	0.817	0.922	1.037	0.843	0.931	1.100

Ca contents are highly satisfactory, irrespective of planting years and soil types. They are always above the commonly accepted critical level of 0.6%.

- Magnesium nutrition (Table V)

Table V: Mg Contents (%)

Plant. Year	LA Year	NB Mg Contents (%) Min	NB Mean	NB Max	TKO Mg Contents (%) Min	TKO Mean	TKO Max
1977	87				0.214	0.262	0.311
	88				0.263	0.288	0.336
	89				0.304	0.317	0.325
1978	87	0.228	0.253	0.295	0.253	0.270	0.297
	88	0.241	0.255	0.281	0.220	0.263	0.297
	89	0.263	0.285	0.320	0.250	0.271	0.289
1979	87	0.255	0.284	0.316	0.211	0.251	0.297
	88	0.236	0.273	0.315	0.236	0.279	0.380
	89	0.259	0.286	0.315	0.267	0.286	0.315
1980	87	0.274	0.306	0.350	0.273	0.326	0.401
	88	0.234	0.289	0.328	0.251	0.323	0.410
	89	0.224	0.293	0.335	0.303	0.340	0.380
1981	87	0.225	0.260	0.301	0.266	0.316	0.351
	88	0.217	0.267	0.350	0.248	0.305	0.378
	89	0.213	0.281	0.347	0.292	0.356	0.457
1982	87	-	0.334	-	-	0.334	-
	88	-	0.287	-	0.281	0.297	0.313
	89	-	0.282	-	0.287	0.288	0.289
1985	88	0.263	0.280	0.294	0.273	0.301	0.366
	89	0.276	0.282	0.288	0.269	0.298	0.335

Mg contents are above the critical level at 0.2% for all the planting years and both the NB and the TKO series.

- Chlorine nutrition (Table VI)

Table VI: Cl Contents (%)

Plant. Year	LA Year	Cl Contents (%) Min	Mean	Max	Cl Contents (%) Min	Mean	Max
		NB			TKO		
1977	87				0.588	0.648	0.695
	88				0.716	0.732	0.775
	89				0.738	0.754	0.847
1978	87	0.554	0.571	0.765	0.494	0.607	0.649
	88	0.608	0.648	0.709	0.616	0.682	0.809
	89	0.627	0.682	0.733	0.685	0.735	0.768
1979	87	0.567	0.625	0.691	0.469	0.591	0.668
	88	0.608	0.658	0.731	0.609	0.659	0.733
	89	0.594	0.684	0.775	0.653	0.732	0.804
1980	87	0.509	0.537	0.599	0.524	0.600	0.713
	88	0.545	0.612	0.655	0.564	0.658	0.728
	89	0.531	0.616	0.668	0.570	0.702	0.781
1981	87	0.431	0.565	0.681	0.578	0.666	0.727
	88	0.441	0.590	0.692	0.626	0.667	0.741
	89	0.497	0.612	0.753	0.601	0.740	0.846
1982	87	-	0.765	-	-	0.693	-
	88	-	0.671	-	0.726	0.800	0.874
	89	-	0.642	-	0.685	0.755	0.826
1985	88	0.714	0.781	0.816	0.701	0.789	0.860
	89	0.668	0.684	0.714	0.643	0.734	0.847

On the whole, chlorine contents are satisfactory to highly satisfactory.

II.2.2. SH and OG

Complete results per plot are given in Annex I.4.

- Nitrogen nutrition (Table VII)

TABLE VII: Comparison between P (LA) and calculated P (N/P ratio)

SMALLHOLDERS					OUTGROWERS				
Planting Year and Soil Type	LA Year	Mean contents N %	P %	P % (N/P ratio)	Planting Year and Soil Type	LA Year	Mean contents N %	P %	P % (N/P ratio)
78 NB	88	2.619	0.153 (92)	0.167					
	89	2.724	0.153 (88)	0.173					
79 NB	88	2.623	0.155 (93)	0.168	79 NB	88	2.663	0.155 (91)	0.170
	89	2.829	0.152 (85)	0.178		89	2.629	0.152 (90)	0.168
80 NB	88	2.690	0.153 (89)	0.171	80 NB	88	2.474	0.144 (90)	0.160
	89	2.707	0.144 (84)	0.172		89	2.481	0.143 (89)	0.161
81 NB	88	2.553	0.154 (94)	0.164	81 NB	88	2.612	0.156 (93)	0.167
	89	2.770	0.156 (89)	0.175		89	2.488	0.149 (93)	0.161
82 NB	89	2.773	0.153 (89)	0.172	82 NB	88	2.493	0.145 (90)	0.161
						89	2.715	0.155 (90)	0.172
78 TKO	88	2.487	0.148 (91)	0.161					
	89	2.566	0.147 (89)	0.165					
79 TKO	88	2.457	0.143 (90)	0.159	79 TKO	88	2.340	0.152 (99)	0.154
	89	2.524	0.142 (87)	0.163		89	2.313	0.142 (93)	0.152
80 TKO	88	2.648	0.164 (97)	0.169	80 TKO	88	2.598	0.153 (92)	0.166
	89	2.819	0.157 (89)	0.177		89	2.481	0.143 (89)	0.161
81 TKO	88	2.689	0.163 (95)	0.171					
	89	2.800	0.156 (89)	0.176					
82 TKO	88	2.687	0.160 (94)	0.171	82 TKO	88	2.137	0.135 (94)	0.144
	89	2.742	0.152 (88)	0.173		89	2.095	0.134 (94)	0.142

N nutrition is generally satisfactory, and the few plots with slightly low N levels are all in poorly-drained bottomlands.

- Phosphate nutrition (Table VII)

For all the planting years, on both NB and TKO soils, there is a more or less marked imbalance in relation to nitrogen nutrition, which worsened between 1988 and 1989. The majority of the plots have P contents within the balance – 0.01 and - 0.02%, or even between - 0.02 and - 0.03%. This imbalance leads to a P deficiency which should be corrected using fertilizer applications.

- Potassium nutrition (Table VIII)

TABLE VIII: K, Ca, Mg and Cl contents for 89 LA

Soil Type	Planting Year	Mean contents K %	Ca %	Mg %	Cl %
SMALLHOLDERS					
NB	78	0.923	0.881	0.250	0.608
	79	0.913	0.966	0.271	0.632
	80	0.816	1.241	0.338	0.620
	81	0.832	1.041	0.288	0.631
	82	0.822	1.035	0.289	0.590
TKO	78	0.816	0.836	0.287	0.715
	79	0.847	0.860	0.285	0.685
	80	0.855	0.989	0.278	0.609
	81	0.769	0.953	0.306	0.691
	82	0.699	1.014	0.291	0.667
OUTGROWERS					
NB	79	0.909	0.860	0.294	0.561
	80	0.827	0.749	0.401	0.354
	81	0.914	0.813	0.296	0.582
	82	1.089	0.888	0.250	0.231
TKO	79	0.655	0.677	0.333	0.599
	80	0.791	0.820	0.343	0.525
	82	0.629	0.849	0.412	0.602
	86 (L9)	0.976	0.748	0.363	0.641

In the case of smallholdings, K nutrition is satisfactory for the 1978 and 1979 plantings on NB, low for the 1981 and 1982 plantings on TKO and average for the others. Contents for the OG are low on TKO and satisfactory on NB, except for the 1980 plantings, which are average.

- Calcium nutrition (Table VIII)

Contents are highly satisfactory in all cases.

- Magnesium nutrition (Table VIII)

Mg nutrition is very good, with contents markedly above the critical level.

- Chlorine nutrition (Table VIII)

This is satisfactory on the whole, but some low contents are seen in the 1980 and 1982 outgrower plantings (NB).

In the case of the SH and OG, it is extremely difficult to determine what fertilizers were actually applied, since the fertilizers distributed are very often not applied. Many bags are left on tracks or in the corners of the plots.

II.3. FERTILIZER RECOMMENDATIONS

These recommendations were based on the 1989 LA data and on trials GH CP 1 and GH CP 2, for which some results are now available.

II.3.1. Schedules

For P, depending on the N/P balance (rate in g/tree of TSP or rock phosphate)*

Difference Theoretical P - P rate (L17)	Planting years 1977-1982		NB and TKO 1985	
0	0		0	
between 0 and 0.010	750	1100*	500	750*
between 0.010 and 0.020	1000	1500*	800	1200
0.020	1500	2300*	1100	1600*

For K, in g of KCl per tree

K% L17	
$K \geq 0.95$	0
$0.90 \leq K < 0.95$	500
$0.85 \leq K < 0.9$	1000
$0.75 \leq K < 0.85$	1500
$0.65 \leq K < 0.75$	2000
$K < 0.65$	2500

II.3.2. Recommendations

Table IX gives fertilizer recommendations in kg per tree and Table X fertilizer requirements for the NES as a whole, in tonnes.

TABLE IX : 1990 fertilizer recommendations

Soil type / Planting years		Ammonium Sulphate (AS) TKO	Ammonium Sulphate (AS) NB	Phosphate TKO TSP	Phosphate TKO RP	Phosphate NB TSP	Phosphate NB RP	Potassium chloride (KCl) TKO	Potassium chloride (KCl) NB
NES	1977	0		0.5	0.75			2.0	-
	1978	0	0	0.5	0.75	0.75	1.1	1.5	0.5
	1979	0	0	1.0	1.5	1.0	1.5	1.0	0.5
	1980	0	0	1.0	1.5	0.75	1.1	1.0	0
	1981	0	0	1.0	1.5	1.0	1.5	2.0	0.5
	1982	0	0	1.5	2.3	1.5	2.3	2.0	0.5
	1985	0	0	0.8	1.2	1.0	1.5	2.0	0.5
SH	1978	0	0	1.0	1.5	1.5	2.3	1.0	0.5
	1979	0	0	1.5	2.3	1.5	2.3	1.0	0.5
	1980	0	0	1.0	1.5	1.0	1.5	1.0	1.0
	1981	0	0	1.0	1.5	1.0	1.5	1.5	1.0
	1982	0	0	1.5	2.3	1.0	1.5	2.0	1.0
OG	1979	0	0	0.75	1.1	1.0	1.5	2.0	0.5
	1980	0	0	1.0	1.5	1.0	1.5	1.5	1.0
	1981	0	0	1.0	1.5	1.0	1.5	1.5	0.5
	1982	0	0	0.75	1.1	1.0	1.5	2.0	0
	1986	0		1.0	1.5			1.5	
	1987	0.8		0.8				1.0	
	1988	0.6		0.6				0.8	
	1989	2x0.2		0.4				2x0.2	
	1990	2x0.1		0.2				2x0.1	

TKO = TEMANG - KOKOFU - ODA NB = NZIMA - BEKWAI

TSP = Triple super phosphate
RP = Rock phosphate

TABLE X: Fertilizer requirements (tonnes) per planting year for the NES

Planting year	Surfaces* ha	AS	P_2O_5 TSP	P_2O_5 RP	KCl	Kieserite
1977 (198)	TKO (100 %)	0	13	20	53.5	0
1978 (616)	TKO (60 %) = 397	0	27	40.5	80	0
	NB (40 %) = 264	0	27	40.5	18.5	0
1979 (811)	TKO (40 %) = 325	0	44	66	44	0
	NB (60 %) = 486	0	66	99	33	0
1980 (1126)	TKO (50 %) = 563	0	76	114	76	0
	NB (50 %) = 563	0	57	85.5	0	0
1981 (392)	TKO (30 %) = 118	0	16	24	32	0
	NB (70 %) = 274	0	37	55.5	18.5	0
1982 (115)	TKO (50 %) = 57	0	11.5	17	15.5	0
	NB (50 %) = 58	0	11.5	17	4	0
1985 (272)	TKO (50 %) = 136	0	14.5	22	37	0
	NB (50 %) = 136	0	18.5	28	9	0
1988 (6)	TKO = 6	0.5	0.5	0.75	0.65	0.3
1983 (2)	TKO = 2	0.1	0.1	0.15	0.1	0.05
1990 (17)	TKO = 17	0.5	0.5	0.75	0.5	0.25
	Total (rounded down)**	1.0	400	600	400	0.6

* estimated for each soil type
** calculation based on 135 trees/hectare, rounded down

II.3.3. Fertilizers applied in 1990

As stated in Document 2278 bis dated August 1990 (section V, p 11), it was decided, at the request of the World Bank mission (Messrs. Singh and Carlier) not to apply fertilizers in 1990, except in young plantings (1985 to 1990). This temporary step, along with others, should enable reductions in production costs per tonne of oil in order to become more competitive in terms of world prices and the local market, which fell during the first half of the year (surplus), from

160,000 to 120,000 cedis per tonne. Halting fertilizer applications in 1990 will save more than 80 million cedis (US$ 240,000), representing 12% of direct costs at the plantation.

However, on account of the low K levels in the plots planted on TKO, it was suggested that 4 kg of ash be applied per tree. Some of the KCl stocks were also used.

Ash and KCl applications in 1990 were as follows, in g per tree:

Planting Year	Plots	Recommended rate: ash	Applied: ash or KCl*
1977	AN1 - 4, BN1 - 4	4000	4000
	BN5 - 8	4000	2000*
1978	AS2 and 3, BS1	2000	1000*
	CN3 and 4, BS 6 - 10		
	CN5 - 11, CS1 and 2	4000	2000*
	CS5 - 7, DS6 - 8		
1979	All	0	0
1980	FN9 - 11, GN5 and 6	4000	0
	HNN14 - 18, GN17 and 18	2000	0
	IN12 - 16, JN16		
1981	FN19 - 22, GN19	4000	0
	IN18 and 19, HN23 and 24		
1982	BS11,12 and 13	4000	2000*

It is worth noting that plots CN1, CS1 and BS1 from the 1978 planting also received sludge, which was applied from a tank in the middle of the free interrow.

The young plantings were given the following fertilizers, in g per tree:

		AS		TSP		KCl		Kieserite	
		R	A	R	A	R	A	R	A
	1985	0	0	800	800	1500	1500	0	0
(ramets)	1988	600	600	600	600	800	800	400	400
(ramets)	1989	2x200	2x200	400	400	2x200	2x200	200	200
(ramets)	1990	2x100	2x100	200	200	2x100	2x100	100	100

R = recommended A = applied

The OPRI trial, set up at GOPDC in 1989, was given 2 x 200 g of AS. 400 g of TSP and 2 x 200 g of KCL have yet to be applied.

II.3.4. Decisions for 1991

The fertilizer recommendations drawn up for 1990 can be used as a basis for estimating 1991 requirements, which will be as follows, in tonnes, for the NES:

	Requirements	Stocks	To be ordered
AS	1.0	60	0
TSP or RP*	400 or 600*	0	400 or 600*
KCl**	400	200	200
Kieserite	0.6	4	0

* Rock phosphate (RP) should be used in preference, since it is much cheaper (US$ 160/tonne compared with US$ 440 for TSP); but the rate should be multiplied by 1.5 (simplification) to take account of its lower P_2O_5 content (28 as against 45%).

** to reduce costs, part of the total could be applied in ash form, doubling the rate.

For all the different fertilizers put together, this means less than 1.8 kg per tree.

The exact rates to apply for each planting year will be more closely defined based on the results of the next leaf samples, planned for December 1990. In addition, they could be identified more clearly for each LA unit, to respond more closely to the requirements of the block in question, within a given planting year.

For the SH and OG, it was seen, as in previous years, that a large proportion of the fertilizers distributed had not been applied (full bags left on the tracks, in the fields, etc.). At the request of Mr. Carlier (World Bank), it was decided to limit fertilizer distribution to the OG (Phase II) to the first year of planting. In subsequent years, GOPDC will only supply fertilizer on a cash-on-delivery basis. In addition, no leaf samples will be taken on the Phase I and II SH and OG in 1990. From then on, samples will be taken every other year, starting in 1991.

For the 1991 planting (750 ha), fertilizer requirements for the OG will be as follows (in tonnes):

AS	20
TSP	20
KCl	20

III. RAMETS

III.1. 1988 AND 1989 PLANTINGS

The 1988 plantings are developing well (see photos in Annex II-1) and the trees already have fine-looking crowns. Table XI gives the results of a survey carried out last November, i.e. 29 months after planting (May 1988).

TABLE XI: Census of inflorescences

Clone No.	Cross	No. of trees			No. of trees			No. of inflorescences		No. of inflo. per live tree
		Planted	Dead	Remaining	Male	Female	No flowers	Male	Female	
C1401	Control PFS* L2T x D10D	117	4	113	6 (5.3)	88 (77.9)	19 (16.8)	26	714	6.3
LMC009	L10T x D8D	135	0	135	30 (22.2)	103 (76.3)	2 (1.5)	103	702	5.2
LMC051	Clone control L2T x D8D	163	2	161	13 (8.1)	115 (71.4)	33 (20.5)	38	903	5.6
LMC026	D3D x L2T	155	2	153	5 (3.3)	103 (67.3)	45 (29.4)	5	601	3.9
LMC043	L10T x D17D	117	0	117	5 (4.3)	105 (89.7)	7 (6.0)	2	904	7.7
LMC074	L452T x DR425-4	138	3	135	23 (17.0)	35 (25.9)	77 (57.0)	71	152	1.1

( ) per cent of living trees
* PFS = produced from seed

Clone LMC 009 is the most precocious, with 98.5% of trees in flower, whilst clone LMC 043 (94% of trees in flower) has the highest proportion of female flowers (89.7%) and is the most productive (7.7 bunches per tree on average). The C 1401 control (produced from seed) comes third in terms of precocity and second in terms of production (6.3 bunches), with the LMC 051 clone control 4th and 3rd respectively.

In terms of growth, LMC 74 is the most vigorous and LMC 009 and 026 grow the most slowly. It is also the least precocious and the least productive (1.1 bunches). Together with its high susceptibility to Cercospora leaf spot, which is seen immediately after planting and persists on older leaves, this makes it the least interesting clone of the 5 tested in the trial.

It is good to see that all the male and female bunches observed are normal and that the mortality rate is very low (1.3%) for the material planted as a whole.

This trial will be harvested for the first time at the start of 1991, i.e. at 2½ years. There are plans to monitor production (number of bunches and weight) and each treatment (5 clones + control produced from seed).

Two methods are proposed for this, and the cheaper and simpler of the two will be chosen:

- individual harvesting, as with fertilizer trials GH CP 1 and 2;
- overall production in each treatment.

These observations will begin at the same time as harvesting.

The following fertilizers were applied in the trial (in g per tree):

Year	AS	TSP	KCl	Kieserite
1988	2 x 100	200	2 x 100	100
1989	2 x 200	400	2 x 200	200
1990	600	600	800	400

Fertilizer rates for 1991 will be based on the results of the first leaf analysis, to be carried out for each treatment in December 1990 (Doc. 2278 bis - page 13). 6 samples will therefore be taken (5 clones plus the control produced from seed).

The 1989 planting (1.8 ha) is developing satisfactorily, but has suffered from grasscutter damage, particularly the section to the West of the 1988 planting. A census of dead trees should be carried out. The fertilizer rates applied to date and recommended for 1991 are as follows:

Year	AS	TSP	KCl	Kieserite
1989	2 x 100	200	2 x 100	100
1990	2 x 200	400	2 x 200	200
1991	600	600	800	400

III.2. 1990 PLANTING

III.2.1. Nursery results

Results are given in Table XII.

As we said in Document 2278 bis (pages 14 and 15), weaning losses were normal for the first batch (Tropiclone) and rather high for the second (La Mé), although prenursery culling was much too strict. This stems from the fact that within the same clone, the physiological age of ramets differs and there is therefore a degree of heterogeneity in their development initially. This heterogeneity is much more marked than with material produced from seed. Selection, based on the homogeneity criterion, should take this into account and be much more flexible. At the end of the prenursery stage, losses (mortality + selection) should not exceed 15% on average.

In this case, and excluding LMC 078, for reasons given in Table XII, losses for the first batch were 33%, and 67.4% for the second. Excessive selection may explain the high losses in the first batch, but do not entirely explain losses in the second, where the mediocre quality of the material should probably be blamed.

In the nursery, the mortality rate, mainly due to Blast, and to a lesser extent Dry Bud Rot, is a little too high (Doc. 2278 bis - page 15), and there are marked variations in susceptibility between the clones. The most tolerant are LMC 044, 052, 090, 103 and 111, involving the L10T parent, and the most susceptible are LMC 022, 051, 072 and 074.

III.2.2. Planting

The planting layout and the characteristics of the clones planted between the 7th and 15th May 1990 are given in Annex II.2.

The number of trees planted per clone and for the C2501 control produced from seed, corresponding to the reproduction of the (D5D x D3D) x L2T hybrid is as follows:

Clone No.	Cross	No. of trees
LMC 022	D115D x L2T	300
044	L10T x D17D	277
051*	L2T x D8D	136
052	D3D x L2T	220
072	L759D x L311P	162
074	L452T x UR425-4	161
090	L10T x D8D	30
103	L10T x D118D	377
111	L10T x D28D	186
2501**		79
	Total	1928, i.e. 13.5 ha

* Clone control
** Control produced from seed

TABLE XII: Clone rearing results for the 1990 planting

Clone No.	Crosses	Weaning Transferred	Prenursery Transferred	Prenursery % loss Weaning	Nursery Transferred	Nursery % loss Prenursery	Dead No.	Dead %	Eliminated (1) No.	Eliminated (1) %	Good plants No.	Good plants %	
1st batch													
LMC 022	D115DxL2T	400	390	2.5	280	28.2	52	18.6	13	4.6	215	76.8	(53.8)
044	L10TxD17D	398	393	1.3	237	39.7	4	1.7	34	14.4	199	84.0	(50.0)
051	L2TxD8D	296	295	0.3	182	38.3	29	15.9	17	9.3	136	74.7	(46.0)
052	D3DxL2T	300	292	2.7	227	22.3	2	0.9	5	2.2	220	96.9	(73.3)
072	L759DxL311P	298	294	1.3	202	31.3	28	13.9	12	5.9	162	80.2	(54.4)
074	L452TxUR425-4	400	393	1.8	232	41.0	28	12.1	43	18.5	161	69.4	(40.3)
078(2)	D10DxL498P	300	270	10.0	96	64.4	8	8.3	88	100.0	0	0	(0)
103	L10TxD118D	606	586	3.3	405	30.9	5	1.2	23	5.7	377	93.1	(62.2)
111	L10TxD28D	296	285	3.7	197	30.9	2	1.0	9	4.6	186	94.4	(62.8)
		3,294	3,198	2.9	2,058	35.7	158	7.7	244	11.9	1,656	80.5	(50.3)
2nd batch													
LMC 022	D115DxL2T	245	244	0.4	97	60.3	9	9.3	3	3.1	85	87.6	(34.7)
044	L10TxD17D	243	219	9.9	82	62.6	3	3.7	1	1.2	78	95.1	(32.1)
090	L10TxD8D	224	209	6.7	40	80.9	1	2.5	9	22.5	30	75.0	(13.4)
		712	672	5.6	219	67.4	13	5.9	13	5.9	193	88.1	(27.1)

(1) Eliminated at selection stage
(2) LMC 078 = numerous losses and poor development. It was requested that this clone not be planted (Doc. 2278 bis - page 15)
( ) per cent good plants in relation to the number of ramets weaned.

Plant appearance is good on the whole (see photos in Annex II-3), except for insufficiently drained areas, where they are yellowish. Efforts should be made during the dry season, to improve drainage.

Fertilizer rates applied in 1990 and recommended for 1991 are as follows (in g per tree):

Year	AS	TSP	KCl	Kieserite
1990	2 x 100	200	2 x 100	100
1991	2 x 200	400	2 x 200	200

IV. PHASE II PLANTINGS

IV.1. NURSERY RESULTS

		Prenursery			
No. of germinated seeds received		169,953			
Seeds eliminated (broken, etc.)			8,735	(5.1%)	
Seeds transferred to prenursery		161,218			
Losses (failed to strike or died)			15,699	(9.7%)	
Eliminated at selection stage			10,519	(6.5%)	(16.2%)
		Nursery			
Transferred to nursery		135,000			
Losses	Blast		2,639	(1.95%)	
	Dry Bud Rot		546	(0.40%)	(2.35%)
	Other		11,446	(8.5%)	
Eliminated at selection stage			7,637	(5.6%)	

	Total lost and eliminated		22,268		(16.5%)
Plants to field		112,732			

Transfer losses are a little too high, whilst those in the prenursery are around normal(16.2% as against 15%). In the nursery, the number of deaths due to Blast and Dry Bud Rot are acceptable (2.4%), as in previous years, due to regular Temik applications and grass elimination. Excluding the 8.5% mortality due to an error made whilst applying a herbicide treatment, total losses, at 8% (mortality = 2.4% + selection = 5.6%) are lower than the generally accepted norm of 10%.

Over all the various stages, the percentage of good plants is 66%.

IV.2. PLANTING

These plants were used as follows:

Outgrowers	103,629	i.e.	724.68 ha
NES	574	i.e.	4.01 ha (extra ramet plot)
OG replacements	8,529	i.e.	59.64 ha
Total	112,732	i.e.	788.33 ha

The 725 ha of OG correspond to 702 ha of new plantings and 23 ha of extensions.

From 1986 to 1990, a total of 3,750 ha will have been planted in OG holdings, under Phase II.

V. OPRI TRIALS

In Doc. 2278 bis, dated August 1990, we pointed out the poor condition of the trial. Since then, the trees have developed satisfactorily (see photos in Annex III), but the mortality rate (47%) is very high. It breaks down as follows for each type of cross:

Crosses	No. of useful trees (1) Planted	Dead	% mortality	
OPRI				
1. G11	80	29	36.3	
2. G59	80	50	62.5	
3. G61	80	40	50.0	
4. G62	80	52	65.0	
5. STD Cross	80	64	80.0	58.8%
IRHO				
6. C1001F	80	22	27.5	
7. C1401	80	34	42.5	
8. C2301F	80	41	51.3	
9. C2401	80	21	26.3	
10. C7001	80	22	27.5	35.0%
Total	800	375	46.9	

(1) Border rows and trees are not taken into account

Whilst some of these losses can be put down to attacks by grasscutters and other rodents, drought, the effects of which were exacerbated by poor soil quality, would seem to be the main cause. It is worth remembering that at the end of November 1989, the water deficit was 557 mm for the NES, i.e. 657 mm on this type of soil, which has lower water reserves.

Significant variations in mortality are seen between crosses: 26 to 27.5% for C2401, 1001F and 7001, 62.5 and 65% for G59 and G62, 80% for the STD cross. Generally speaking, the IRHO material is less severely affected: 35% as against 58.8%.

As OPRI did not make these counts until last September, it was not possible to plant replacements in April-May 1990, as they should have been, or in October, since GOPDC was informed too late (start of November) and did not have any plants in the nursery. They will therefore be planted in April-May 1991, i.e. 2 years after planting, and for the IRHO material, only crosses C1001F, C2301F and C1401 will be available.

This high mortality rate, in addition to replacements that will be planted too late and will be incomplete, casts doubt upon the wisdom of continuing the trial, the results of which will no longer be usable. Mr. Meunier, IRHO genetics consultant with OPRI, was asked to talk to the Directors of the Institute during his December 1990 visit about what should be decided.

If the trial is halted, it would still be best to continue replacements and consider the plot as a commercial plot, or to sell it to growers, since it is so far away.

ANNEXES

ANNEXES I

Mineral Nutrition

GHANA
GOPDC

GH CP 01
GH CP 02

COMPARISON BETWEEN THE 1989 RESULTS FOR EXPERIMENTS GH CP 01 AND GH CP 02

	GH CP 01			GH CP 02		
Planting year	1978			1977		
Plots	CN 2			AN 1		
Start of experiment	1984			1984		
Soil	NZIMA pebbly series			TEMANG waterlogged series		
Depth (cm)	0-20	20-40	40-60	0-20	20-40	40-60
Texture % (C + fS)	46	47	48	11	13	18
Organic carbon (%)	2.2			1.5		
Total nitrogen (%)	2.5			1.6		
Total P ppm	345			164		
Assim. P (Olsen) ppm	12			17		
Exchangeable K me/100g	0.35			0.08		
" Mg me/100g	1.7			0.61		
" Ca me/100g	5.9			3.84		
" CEC me/100g	8.0			5.0		
Water pH	5.4			5.7		
Phytosanitary condition	Heavy defoliation in 1987 due to Coelaenomenodera			Heavy defoliation in 1987 due to Coelaenomenodera		
Nitrogen nutrition	Contents naturally high			Contents naturally satisfactory		
	No N fertilizer required since at least 1984			No N fertilizer required since at least 1984		
Phosphorus nutrition	High natural deficiency Still not properly corrected in 1989 by 1000 g of triple super			Natural deficiency Corrected in 1989 by 1000 g of triple super		
Potassium nutrition	Naturally satisfactory KCl applications not required			High K deficiency, only partially corrected by high KCl applications (3 kg per tree)		
Magnesium nutrition	Contents naturally satisfactory, high in certain years			Contents naturally very high, depressed by KCl applications, but still remain high		
	Kieserite applications not necessary			Kieserite applications not necessary		

GHANA
GOPDC
1977 planting
Plot CN 2

GH CP 01
Set up in 1984

1989 RESULTS

It should be remembered that the experiment suffered from very severe defoliation at the beginning of 1987, following coelaenomenodera attacks.

MINERAL NUTRITION

Leaf contents in December 1989

NITROGEN NUTRITION

The treatments have had no effect on contents, whose mean value of 2.73% is highly satisfactory. No plot has contents under 2.50%.

PHOSPHORUS NUTRITION

For the 2nd year running, phosphate has increased the P contents (linear effect). The maximum content (0.164%) was reached with the highest phosphorus rate (1000 g of triple super), but the increase compared to the control P0 (0.158%) is not very high (+ 3%) and still does not make it possible to attain the value deduced from the N/P balance.

	%N	actual %P	%P according to N/P balance
P0	2.729	0.158	0.173
P1	2.701	0.160	0.171
P2	2.753	0.164*	0.174

It is interesting to note that at the end of its investigation into the phosphorus status of the soils (1976–78), the World Phosphate Institute concluded "soil clearly deficient in phosphoric acid, correction is called for".

POTASSIUM NUTRITION

Despite the fact that KCl has not been applied since 1983, the content of treatment KC10 (1,050%) is satisfactory and has not changed since 1984. All the plot contents, except for one, are over 0.9%.

KCl has no effect on the contents of KC11 and KC12, which have also been very stable for the last 6 years.

CALCIUM NUTRITION

For the first time, phosphate increased the calcium contents of treatment P2 (linear effect). Due to the general effect, the mean $\frac{P1 + P2}{2} = 0.791\%$ is significantly different from the contents of P0 (0.743%).

MAGNESIUM NUTRITION

The mean content of the experiment increased substantially in 1989, reaching 0.277%. All the plot contents - except one - are equal to or greater than 0.24%.

CHLORIDE NUTRITION

The content of treatment KC10 (0.493%) was relatively high this year. The relative increase in Cl contents due to KCl applications seems to have been stable for the last 2 years.

Effect of KCl on Cl contents

	2/1984	1/1986	12/1987	12/1988	12/1989
Contents of KC10	.559	.346	.438	.426	.493
(KC11/KC10) x 100	94	109	113	120*	121**
(KC12/KC10) x 100	106	123**	133**	138**	139**

SULPHUR NUTRITION

The treatments had no effect on sulphur nutrition; the mean content (0.212%) is satisfactory.

1989 PRODUCTION

Mean trial production has considerably improved, increasing from 53 kg FFB/tree in 1988 to 93 kg FFB/tree in 1989. Hence, this year, production was close to 12.5 t/ha (93 kg x 135 trees).

This year, in treatment P2 (1 kg of triple super applied for the last 5 years), partial correction of the phosphorus deficiency has led to a significant increase of 11% (10 kg/tree) in bunch production, through an increase in their number.

1990 FERTILIZATION

The results obtained for both mineral nutrition and production call for an increase in the triple superphosphate rate, so as to obtain a P content corresponding to the N/P balance.

Levels	KCl	Triple Super	Urea
0	0	0	0
1	500	750	0
2	1000	1500	0

CONCLUSION

Only phosphate fertilizer is necessary for the plantings on NZIMA series soils under the experimental conditions in question. An annual application of 1 kg of triple super, or the equivalent rate of single super over 5 years, has partially corrected the phosphorus deficiency according to leaf contents and led to an increase of 10 kg FFB/tree in 1989. This yield increase will most probably be cost—effective if it is maintained.

GH CP 01 SOIL ANALYSES - MEAN CONTENTS

Samples taken from plots 2-8-9-12-15-18-20-23-26

Depth (cm)	0-20	20-40	40-60
TEXTURE			
Clay %	34.4	35.7	38.1
Fine silts %	12.1	11.1	9.8
Coarse silts %	17.0	15.6	11.6
Fine sand %	22.1	18.0	14.0
Coarse sand %	14.4	19.6	26.5
ORGANIC MATTER			
Organic matter %	3.78		
Carbon %	2.19		
Total nitrogen %	2.50		
C/N ratio %	8.8		
PHOSPHORUS			
Total P (ppm)	345		
Assimilable P (ppm) (Olsen)	12		
ABSORBING COMPLEX			
$Co(NH_3)6\ Cl_3$ Method: Ca	5.88		
Mg	1.66		
K	0.35		
Na	0.04		
Al	0.13		
H	0.04		
CEC	7.96		
pH of the $Co(NH_3)6\ Cl_3$ extract	5.07		
pH RATIO ½, 5			
Water pH	5.39		
KCl pH	4.47		

GHANA - GOPDC
KWAE Estate - Plot CN2
Started in 1984
Year of planting : 1977

GH CP 01

1-1

FERTILIZER TRIAL

- Statistical Design : Factorial 3 x 3 x 3

- Treatments :

  3 levels of Ammonium sulphate : N 20 % - S 23 %

  3 levels of Single super phosphate : P2O5 20 % - CaO 25 % - S 12 %
  or Triple super phosphate : P2O5 35 % - CaO 17 %

  3 levels of Muriate of potash : K2O 60 % - Cl 45 %

- Soils : NZIMA series

- Fertilizer rates (g/palm/year)

  Before 1984 : Same manuring than the estate.

	Ammonium sulfate			Single super / Triple super *			KCl		
Levels	0	1	2	0	1	2	0	1	2
November 1984	0	1000	2000	0	1000	2000	0	1000	2000
February 1985	0	0	0	0	1100	2200	0	500	1000
1986					Nil				
July 1987	0	0	0	0	500*	1000*	0	500	1000
July 1988	0	0	0	0	1100*	2200*	0	500	1000
July 1989	0	0	0	0	500*	1000*	0	500	1000

LEAF ANALYSIS

			N0	N1	N2	P0	P1	P2	K0	K1	K2	L.S.D. 5 %	L.S.D. 1 %
N	Dec. 88	17	2.83	2.82	2.83	2.80	2.84	2.84	2.83	2.82	2.83	0.064	0.088
	Dec. 89	17	2.74	2.70	2.74	2.73	2.70	2.75	2.74	2.75	2.69	0.091	0.126
P	Dec. 88	17	.162	.162	.162	.159	.163*	.164**	.162	.162	.163	0.003	0.004
	Dec. 89	17	.162	.160	.160	.158	.160	.164*	.162	.161	.160	0.005	0.007
K	Dec. 88	17	1.033	.965	.945*	1.008	.970	.966	.993	.958	.992	0.086	0.119
	Dec. 89	17	1.091	1.031	1.036	1.100	1.031	1.026	1.050	1.063	1.045	0.088	0.122
Ca	Dec. 88	17	.778	.808	.792	.776	.803	.799	.777	.831	.770	0.043	0.060
	Dec. 89	17	.758	.804	.763	.743	.772	.810*	.778	.765	.782	0.052	0.072
Mg	Dec. 88	17	.242	.244	.235	.232	.245	.245	.236	.233	.253	0.027	0.037
	Dec. 89	17	.274	.281	.278	.265	.281	.287*	.276	.270	.287	0.018	0.024
Cl	Dec. 88	17	.530	.509	.484	.528	.500	.495	.426	.512*	.586**	0.070	0.096
	Dec. 89	17	.597	.594	.581	.602	.570	.600	.493	.596**	.683**	0.066	0.091
S	Dec. 89	17	.210	.211	.217	.211	.211	.215	.215	.213	.210	0.008	0.011

PRODUCTION

	N0	N1	N2	P0	P1	P2	K0	K1	K2	L.S.D. 5 %	L.S.D. 1 %
kg of bunches/tree											
1988	49	55	55	53	53	53	49	59	51	9.6	13.3
1989	93	97	89	88	93	98*	94	88	97	8.6	11.9
Number of bunches/tree											
1988	4.8	5.4	5.5	5.3	5.2	5.3	5.2	5.8	4.8	1.0	1.4
1989	6.7	6.5	6.5	6.1	6.6	7.0**	6.7	6.1	6.8	0.74	1.02
Mean bunch weights											
1988	10.3	10.4	9.9	10.0	10.3	10.2	9.6	10.2	10.8	1.2	1.7
1989	13.9	15.1	13.9	14.5	14.2	14.2	14.2	14.4	14.3	1.5	2.0

PALMIER DATE D'EDITION : 1990/ 7/ 4

GHANA GHCP01 DF 12/89 RG17 (CN2)

NUMERO DE LA DEMANDE : 149
****

DR 11/05/90

N° DU PROBLEME :

CAMPAGNE D.F. : 90

TRAIT	NB	NR	PAR	NULAB	N	P	K	CA	MG	CL	S
NPK 002	1		1	5253	2.793	0.158	1.090	0.733	0.292	0.693	0.197
010	1		8	5254	2.723	0.162	1.139	0.676	0.291	0.552	0.195
021	1		5	5255	2.988	0.171	1.092	0.754	0.283	0.645	0.219
100	1		2	5256	2.667	0.155	0.999	0.797	0.268	0.583	0.201
111	1		9	5257	2.658	0.156	0.924	0.808	0.285	0.530	0.201
122	1		4	5258	2.622	0.161	0.953	0.875	0.279	0.703	0.204
201	1		7	5259	2.891	0.164	1.146	0.698	0.280	0.626	0.222
~~T9~~				~~5260~~	~~2.691~~	~~0.166~~	~~0.936~~	~~0.765~~	~~0.292~~	~~0.610~~	~~0.208~~
212	1		3	5261	2.605	0.156	0.975	0.842	0.273	0.689	0.202
220	1		6	5262	2.889	0.170	1.111	0.775	0.308	0.540	0.220
001	2		13	5263	2.623	0.154	1.112	0.780	0.213	0.511	0.194
012	2		11	5264	2.672	0.162	1.015	0.828	0.273	0.591	0.203
020	2		18	5265	2.661	0.163	1.072	0.805	0.263	0.390	0.212
102	2		16	5266	2.694	0.160	1.258	0.750	0.271	0.770	0.201
110	2		15	5267	2.747	0.165	1.066	0.834	0.286	0.377	0.215
121	2		14	5268	2.746	0.163	1.102	0.799	0.285	0.623	0.211
200	2		10	5269	2.767	0.162	1.031	0.744	0.240	0.408	0.225
211	2		17	5270	2.756	0.162	1.072	0.745	0.244	0.544	0.219
222	2		12	5271	2.691	0.161	0.974	0.804	0.267	0.654	0.214
000	3		21	5272	2.780	0.166	1.215	0.705	0.253	0.589	0.225
011	3		27	5273	2.667	0.160	1.083	0.717	0.297	0.713	0.214
022	3		25	5274	2.772	0.164	0.999	0.822	0.298	0.691	0.227
101	3		22	5275	2.698	0.155	0.996	0.798	0.245	0.549	0.223

TRAIT NPK	NB	NR	PAR	NULAB	N	P	K	CA	MG	CL	S
112	3		26	5276	2.761	0.165	1.087	0.703	0.305	0.670	0.223
120	3		19	5277	2.706	0.158	0.892	0.875	0.301	0.537	0.217
202	3		24	5278	2.648	0.151	1.054	0.680	0.321	0.690	0.215
210	3		20	5279	2.710	0.155	0.922	0.795	0.275	0.461	0.225
T9				~~5280~~	~~2.660~~	~~0.163~~	~~0.965~~	~~0.792~~	~~0.006~~	~~0.610~~	~~0.221~~
221	3		23	5281	2.699	0.163	1.042	0.784	0.295	0.620	0.212

**************************EXPERIENCE: GALF01 **************
MOYENNE DE LA VARIABLE:N pour les annees: 69

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES	
N 0	2.730	2.687	2.807	2.741	100
N 1	2.687	2.723	2.693	2.701	98.54
N 2	2.770	2.693	2.760	2.741	100.00

MOYENNE BLOC 1 2.7600
MOYENNE BLOC 2 2.7067
MOYENNE BLOC 3 2.7167

	K 0	K 1	K 2	MOYENNES	
P 0	2.740	2.737	2.710	2.729	100
P 1	2.727	2.697	2.680	2.701	98.98
P 2	2.753	2.813	2.693	2.753	100.90

	N 0	N 1	N 2	MOYENNES	
K 0	2.720	2.710	2.790	2.740	100
K 1	2.760	2.703	2.783	2.749	100.32
K 2	2.743	2.690	2.650	2.694	98.34

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.202067			
BLOC	2		0.014467	0.0072	0.87	0.44
N L	1	0.000	0.000000		0.00	0.95
N C	1	0.080	0.009600		1.16	0.30
N G	1	-0.040	0.002400		0.29	0.60
N A	1	0.040	0.007200		0.87	0.38
P L	1	0.024	0.002689		0.33	0.58
P C	1	0.080	0.009600		1.16	0.30
P G	1	-0.003	0.000017		0.00	0.92
P A	1	0.052	0.012272		1.48	0.24
K L	1	-0.046	0.009339		1.13	0.31
K C	1	-0.063	0.006017		0.73	0.42
K G	1	-0.037	0.002017		0.24	0.63
K A	1	-0.054	0.013339		1.61	0.22
N L*P L	1	-0.043	0.005633		0.68	0.43
N L*K L	1	-0.082	0.020008		2.42	0.14
P L*K L	1	-0.015	0.000675		0.08	0.77
ERREUR	15		0.124039	0.0083		

	D.S.5%	D.S.1%
EFFETS L.A	0.0914	0.1263
EFFETS C,G	0.1582	0.2188
INT LL	0.1119	0.1547

MOYENNE GENERALE 2.7278
C.V. 3.33

**************************EXPERIENCE: GHCP01 **************************

MOYENNE DE LA VARIABLE:P pour les annees: 87

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.159	0.161	0.166	0.162	100	MOYENNE BLOC 1	0.1614 –
N 1	0.157	0.162	0.161	0.160	98.49	MOYENNE BLOC 2	0.1613 –
N 2	0.159	0.158	0.165	0.160	98.90	MOYENNE BLOC 3	0.1597 –

	K 0	K 1	K 2	MOYENNES	
P 0	0.161	0.158	0.156	0.158	100
P 1	0.161	0.159	0.161	0.160	101.26
P 2	0.164	0.166	0.162	0.164*	103.44

	N 0	N 1	N 2	MOYENNES	
K 0	0.164	0.159	0.162	0.162	100
K 1	0.162	0.158	0.163	0.161	99.45
K 2	0.161	0.162	0.156	0.160	98.76

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.000598			
BLOC	2		0.000018	0.0000	0.35	0.71
N L	1	-0.002	0.000014		0.57	0.47
N C	1	0.003	0.000015		0.58	0.47
N G	1	-0.004	0.000027		1.06	0.32
N A	1	0.001	0.000002		0.08	0.77
P L	1	0.005	0.000133		5.30 *	0.03
P C	1	0.001	0.000003		0.12	0.73
P G	1	0.007	0.000083		3.30	0.09
P A	1	0.003	0.000053		2.12	0.16
K L	1	-0.002	0.000018		0.72	0.42
K C	1	-0.000	0.000000		0.00	0.91
K G	1	-0.003	0.000013		0.50	0.50
K A	1	-0.001	0.000006		0.22	0.65
N L*P L	1	-0.001	0.000001		0.03	0.84
N L*K L	1	-0.002	0.000012		0.48	0.51
P L*K L	1	0.001	0.000007		0.27	0.62
ERREUR	15		0.000377	0.0000		

	D.S.5%	D.S.1%
EFFETS L.A	0.0050	0.0070
EFFETS C,G	0.0087	0.0121
INT LL	0.0062	0.0085

MOYENNE GENERALE 0.1608
C.V. 3.12

*************************EXPERIENCE: GHCP01 *************************

MOYENNE DE LA VARIABLE:K pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	1.139	1.079	1.054	1.091	100	MOYENNE BLOC 1	1.0477
N 1	1.084	1.026	0.982	1.031	94.50	MOYENNE BLOC 2	1.0780
N 2	1.077	0.990	1.042	1.036	95.01	MOYENNE BLOC 3	1.0322

	K 0	K 1	K 2	MOYENNES	
P 0	1.082	1.085	1.134	1.100	100
P 1	1.042	1.026	1.026	1.031	93.76
P 2	1.025	1.079	0.975	1.026	93.29

	N 0	N 1	N 2	MOYENNES	
K 0	1.142	0.786	1.021	1.050	100
K 1	1.096	1.007	1.087	1.063	101.29
K 2	1.035	1.099	1.001	1.045	99.56

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.192572			
BLOC	2		0.009763	0.0049	0.63	0.55
N L	1	-0.054	0.013339		1.73	0.21
N C	1	0.066	0.006446		0.84	0.39
N G	1	-0.114	0.019646		2.55	0.13
N A	1	0.006	0.000139		0.02	0.86
P L	1	-0.074	0.024494		3.18	0.09
P C	1	0.064	0.006059		0.79	0.40
P G	1	-0.142	0.030436		3.95	0.06
P A	1	-0.005	0.000118		0.02	0.87
K L	1	-0.005	0.000098		0.01	0.88
K C	1	-0.032	0.001515		0.20	0.67
K G	1	0.009	0.000119		0.02	0.87
K A	1	-0.018	0.001494		0.19	0.67
N L*P L	1	0.025	0.001875		0.24	0.63
N L*K L	1	0.044	0.005677		0.74	0.41
P L*K L	1	-0.051	0.007803		1.01	0.33
ERREUR	15		0.115504	0.0077		

	D.S.5%	D.S.1%
EFFETS L,A	0.0882	0.1219
EFFETS C,G	0.1527	0.2111
INT LL	0.1080	0.1493

MOYENNE GENERALE 1.0526

C.V. 8.34

MOYENNE DE LA VARIABLE:CA pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.739	0.740	0.794	0.758	100	MOYENNE BLOC 1	0.7731
N 1	0.782	0.782	0.850	0.804	106.14	MOYENNE BLOC 2	0.7877
N 2	0.707	0.794	0.788	0.763	100.69	MOYENNE BLOC 3	0.7643

	K 0	K 1	K 2	MOYENNES	
P 0	0.749	0.759	0.721	0.743	100
P 1	0.768	0.757	0.791	0.772	103.93
P 2	0.818	0.779	0.834	0.810*	109.09

	N 0	N 1	N 2	MOYENNES	
K 0	0.729	0.835	0.771	0.778	100
K 1	0.750	0.802	0.742	0.765	98.24
K 2	0.794	0.776	0.775	0.782	100.44

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.080807			
BLOC	2		0.002500	0.0013	0.47	0.64
N L	1	0.005	0.000123		0.05	0.81
N C	1	-0.088	0.011587		4.38	0.05
N G	1	0.052	0.004021		1.52	0.24
N A	1	-0.041	0.007688		2.90	0.11
P L	1	0.068	0.020537		7.76 *	0.01
P C	1	0.009	0.000125		0.05	0.81
P G	1	0.097	0.014049		5.31 *	0.03
P A	1	0.038	0.006612		2.50	0.13
K L	1	0.003	0.000053		0.02	0.86
K C	1	0.031	0.001421		0.54	0.48
K G	1	-0.010	0.000157		0.06	0.80
K A	1	0.017	0.001318		0.50	0.50
N L*P L	1	0.013	0.000507		0.19	0.67
N L*K L	1	-0.031	0.002852		1.08	0.32
P L*K L	1	0.022	0.001387		0.52	0.49
ERREUR	15		0.039716	0.0026		

	D.S.5%	D.S.1%
EFFETS L,A	0.0517	0.0715
EFFETS C,G	0.0895	0.1238
INT LL	0.0633	0.0876

MOYENNE GENERALE 0.7750
C.V. 6.64

************************EXPERIENCE: GHCP01 ************************ [illegible]

MOYENNE DE LA VARIABLE:MG pour les annees: 89

TABLEAUX CROISES

	F 0	F 1	F 2	MOYENNES			
N 0	0.253	0.287	0.281	0.274	100	MOYENNE BLOC 1	0.2843
N 1	0.261	0.292	0.288	0.281	102.52	MOYENNE BLOC 2	0.2602
N 2	0.280	0.264	0.290	0.278	101.62	MOYENNE BLOC 3	0.2878

	K 0	K 1	K 2	MOYENNES	
F 0	0.254	0.246	0.295	0.265	100
F 1	0.284	0.275	0.284	0.281	106.13
F 2	0.291	0.288	0.281	0.287	108.22

	N 0	N 1	N 2	MOYENNES	
K 0	0.269	0.285	0.274	0.276	100
K 1	0.264	0.272	0.273	0.270	97.67
K 2	0.288	0.285	0.287	0.287	103.78

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.014699			
BLOC	2		0.004058	0.0020	6.60 **	0.01
N L	1	0.004	0.000089		0.29	0.60
N C	1	-0.009	0.000131		0.43	0.53
N G	1	0.011	0.000193		0.63	0.45
N A	1	-0.002	0.000027		0.09	0.76
F L	1	0.022	0.002134		6.94 *	0.02
F C	1	-0.011	0.000171		0.56	0.47
F G	1	0.038	0.002166		7.05 *	0.02
F A	1	0.006	0.000139		0.45	0.52
K L	1	0.010	0.000491		1.60	0.22
K C	1	0.023	0.000817		2.66	0.12
K G	1	0.004	0.000024		0.08	0.77
K A	1	0.017	0.001284		4.18	0.06
N L*F L	1	-0.010	0.000271		0.88	0.38
N L*K L	1	-0.003	0.000027		0.09	0.76
F L*K L	1	-0.025	0.001900		6.18 *	0.02
ERREUR	15		0.004611	0.0003		

	D.S.5%	D.S.1%
EFFETS L.A	0.0176	0.0244
EFFETS C,G	0.0305	0.0422
INT LL	0.0216	0.0298

MOYENNE GENERALE 0.2774
C.V. 6.32

*************************EXPERIENCE: GHCP01 ****************************

MOYENNE DE LA VARIABLE:CL pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.598	0.619	0.575	0.597	100	MOYENNE BLOC 1	0.6179
N 1	0.634	0.526	0.621	0.594	99.39	MOYENNE BLOC 2	0.5409
N 2	0.575	0.565	0.605	0.581	97.34	MOYENNE BLOC 3	0.6133

	K 0	K 1	K 2	MOYENNES	
P 0	0.527	0.562	0.718	0.602	100
P 1	0.463	0.596	0.650	0.570	94.61
P 2	0.489	0.629	0.683	0.600	99.70

	N 0	N 1	N 2	MOYENNES	
K 0	0.510	0.499	0.470	0.493	100
K 1	0.623	0.567	0.597	0.596	120.82
K 2	0.658	0.714	0.678	0.683	138.63

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.273278			
BLOC	2		0.033594	0.0168	3.93 *	0.04
N L	1	-0.016	0.001136		0.27	0.62
N C	1	-0.009	0.000110		0.03	0.85
N G	1	-0.020	0.000574		0.13	0.72
N A	1	-0.012	0.000672		0.16	0.70
P L	1	-0.002	0.000014		0.00	0.91
P C	1	0.063	0.005975		1.40	0.25
P G	1	-0.034	0.001757		0.41	0.54
P A	1	0.031	0.004232		0.99	0.35
K L	1	0.190	0.163211		38.17 **	0.00
K C	1	-0.015	0.000333		0.08	0.77
K G	1	0.293	0.128871		30.14 **	0.00
K A	1	0.088	0.034672		8.11 *	0.01
N L*P L	1	0.026	0.002054		0.48	0.51
N L*K L	1	0.030	0.002700		0.63	0.45
P L*K L	1	0.001	0.000005		0.00	0.92
ERREUR	15		0.064146	0.0043		

	D.S.5%	D.S.1%
EFFETS L.A	0.0657	0.0908
EFFETS C.G	0.1138	0.1574
INT LL	0.0805	0.1113

MOYENNE GENERALE 0.5907

C.V. 11.07

**************************EXPERIENCE: GHCP01 *************************   13-08-1990   07:30:31   ************

MOYENNE DE LA VARIABLE:S   pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.205	0.204	0.219	0.210	100	MOYENNE BLOC 1	0.2068
N 1	0.208	0.213	0.211	0.211	100.53	MOYENNE BLOC 2	0.2104
N 2	0.221	0.215	0.215	0.217	103.61	MOYENNE BLOC 3	0.2201

	K 0	K 1	K 2	MOYENNES	
P 0	0.217	0.213	0.204	0.211	100
P 1	0.212	0.211	0.209	0.211	99.68
P 2	0.216	0.214	0.215	0.215	101.73

	N 0	N 1	N 2	MOYENNES	
K 0	0.211	0.211	0.223	0.215	100
K 1	0.209	0.212	0.218	0.213	98.97
K 2	0.209	0.209	0.210	0.210	97.47

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.002729			
BLOC	2		0.000854	0.0004	7.37 **	0.01
N L	1	0.008	0.000257		4.43	0.05
N C	1	0.005	0.000043		0.74	0.41
N G	1	0.009	0.000113		1.94	0.18
N A	1	0.006	0.000187		3.23	0.09
P L	1	0.004	0.000060		1.04	0.32
P C	1	0.005	0.000037		0.65	0.44
P G	1	0.003	0.000013		0.23	0.64
P A	1	0.004	0.000084		1.46	0.24
K L	1	-0.005	0.000133		2.30	0.15
K C	1	-0.001	0.000002		0.03	0.85
K G	1	-0.008	0.000088		1.52	0.23
K A	1	-0.003	0.000047		0.81	0.39
N L*P L	1	-0.010	0.000280		4.84 *	0.04
N L*K L	1	-0.006	0.000096		1.66	0.21
P L*K L	1	0.006	0.000096		1.66	0.21
ERREUR	15		0.000869	0.0001		

	D.S.5%	D.S.1%
EFFETS L.A	0.0076	0.0106
EFFETS C.G	0.0132	0.0183
INT LL	0.0094	0.0130

MOYENNE GENERALE 0.2124

C.V. 3.58

GHANA
GOPDC
1977 planting
Plot AN1

GH CP 02
Set up in 1984

1989 RESULTS

It should be remembered that the experiment suffered from very severe defoliation at the beginning of 1987, following coelaenomenodera attacks.

MINERAL NUTRITION

Leaf contents in December 1989.

NITROGEN NUTRITION

Treatments have had no effect on contents, whose mean value of 2.57% is satisfactory. Twenty-one plots have contents higher than 2.50% and the contents of six of them range from 2.4 to 2.5%.

PHOSPHORUS NUTRITION

As in December 1988, the linear and general effects of phosphate fertilizer on P contents were almost significant or significant.

	1988	1989	
	%P	%P	%P according to N/P balance
PO	.161 (100)	.156 (100)	.166
P1	.166 (103)	.159 (102)	.166
P2	.166 (103)	.161 (103)	.163
Linear effect F probability	6% a	7% a	
General effect F probability	3% b	7% a	

a = almost significant effect
b = significant effect

In 1989, rate 2 of triple super (1000 g/tree) made it possible to obtain the optimum P rate deduced from the N/P balance relationship.

POTASSIUM NUTRITION

Since 1986, the contents of KC10 have fluctuated around 0.7%; in 1989 they were 0.690%. This low value reveals a severe potassium deficiency, which has only been partially corrected by KCl applications.

K contents from 1987 to 1989
(1st KCl application in 1984)

	KC10	KC11	KC12
1987	.711	.740	.828**
1988	.769	.833	.907**
1989	.690	.734	.830**
Mean	.723 (100)	.769 (100)	.855 (118)

The content distribution table for December 1989 shows that the values are quite scattered, especially those for treatments KC10 and KC12.

1989 - Distribution of K contents

%K	0.5		0.6		0.7		0.8		0.9		1.0		Total
KC10		1		5		2		0		1		0	9
KC11		0		3		6		0		0		0	9
KC12		0		1		3		3		1		1	9

Since the first KCl application in November 1984, fertilizer effects have been as follows:

a) The content of KC12 has been higher than that of KC10 (control) since 1986, whereas that of the mean $\frac{K1 + K2}{2}$ has been higher since 1987.

b) However, the content of KC12 was only greater than that of KC11 in 1987 and 1989 (in 1988, F probability reached 12% all the same).

c) In addition, the content of KC11 has never been greater than that of KC10.

CALCIUM NUTRITION

Treatments still have no effect on contents, whose mean value (0.789%) is satisfactory.

MAGNESIUM NUTRITION

As in the previous two years (1987-1988), KCl greatly depresses Mg contents, but the content of KC12 (%Mg = 0.288%) remains very high. The lowest plot content, 0.242%, is still high. Curiously, the contents that dropped between 1984 and 1986 in all treatments have been following a rising curve since 1987.

CHLORIDE NUTRITION

Even without fertilizer, the content has always been high. In 1989, it reached 0.714%. For the first time, KCl at the highest rate significantly increased Cl- contents.

SULPHUR NUTRITION

The treatments have no effect on contents, whose mean value, 0.186%, is satisfactory.

1989 PRODUCTION

Mean trial production has improved little compared to the previous year. In 1988, it was 68 kg FFB/tree (9.2 t ha^{-1}) and in 1989 it just reached 76 kg/tree (10.3 t ha^{-1}).

The plot production distribution table shows that the figures are highly dispersed, especially those for treatment KC12. The trial must still be suffering from the effects of defoliation in 1987. The number of bunches harvested per tree only just amounts to 3.6.

1989 - Plot Production Distribution

kg/tree	40–50	50–60	60–70	70–80	80–90	90–100	100–110	110–120	120–130
KC10	0	2	3	0	2	1	0	0	1
KC11	0	0	3	4	1	0	1	0	0
KC12	1	1	2	1	1	2	1	0	0

The treatments still have <u>no</u> effect on production, despite partial correction of the potassium deficiency.

1990 FERTILIZATION

In 1989, rate 2 of triple super made it possible to reach the optimum P rate. Rate 2 of KCl does not make it possible to keep the K content above 0.9%. However, since this rate is already high (3 kg of KCl) it does not seem worthwhile to increase it.

The 1989 rates will therefore also be applied in 1990.

CONCLUSION

According to the leaf contents, phosphate fertilizer at rate 2 makes it possible to correct a phosphorus deficiency, whereas the highest KCl rate does not currently make it possible to correct the severe potassium deficiency, which appears to be characteristic of TEMANG series soils.

The lack of any treatment effect on production - probably still adversely affected by defoliation in 1987 - prevents any other conclusions from being drawn.

GH CP 02 SOIL ANALYSES - MEAN CONTENTS

Samples taken from plots 1-5-9-10-14-18-20-24-25

Depth (cm)		0-20	20-40	40-60
TEXTURE				
Clay %		9.5	6.9	11.1
Fine silts %		6.6	6.5	7.0
Coarse silts %		16.9	16.0	15.5
Fine sand %		31.4	30.1	25.3
Coarse sand %		35.6	40.5	40.9
ORGANIC MATTER				
Organic matter %		2.63*		
Carbon %		1.53*		
Total nitrogen %		1.55*		
C/N ratio %		10.1*		
PHOSPHORUS				
Total P (ppm)		164		
Assimilable P (ppm) (Olsen)		17		
ABSORBING COMPLEX				
$Co(NH_3)6\ Cl_3$ Method	Ca	3.84*		
	Mg	0.61*		
	K	0.08*		
	Na	0.09*		
	Al	0.00*		
	H	0.01*		
	CEC	5.03*		
	pH of the $Co(NH_3)6\ Cl_3$ extract	5.49*		
pH RATIO ½, 5				
Water pH		5.69*		
KCl pH		4.93*		

* With 8 plots

GHANA - GOPDC
KWAE Estate - Plot AN1
Started in 1984
Year of planting : 1977

GH CP 02

1-1

FERTILIZER TRIAL

- Statistical Design : Factorial 3 x 3 x 3

- Treatments :

    3 levels of Ammonium sulphate : N 20 % - S 23 %

    3 levels of Super single phosphate : P2O5 20 % - CaO 25 % - S 12 %
    or Triple super phosphate : P2O5 35 % - CaO 17 %

    3 levels of Muriate of potash : K2O 60 % - Cl 45 %

- Soils : TEMANG series

- Fertilizer rates (g/palm/year)

	Ammonium sulfate			Single super / Triple super *			KCl		
Levels	0	1	2	0	1	2	0	1	2
November 1984	700	1500	3000	0	1200	2400	0	1300	2600
February 1985	0	0	0	0	1100	2200	0	1300	2600
1986					Nil				
July 1987	0	1000	2000	0	500*	1000*	0	2000	4000
July 1988	0	0	0	0	500*	1000*	0	1500	3000
July 1989	0	0	0	0	500*	1000*	0	1500	3000

LEAF ANALYSIS

			N0	N1	N2	P0	P1	P2	K0	K1	K2	L.S.D. 5 %	L.S.D. 1 %
N	Dec. 88	17	2.64	2.62	2.63	2.63	2.65	2.61	2.63	2.61	2.65	0.061	0.084
	Dec. 89	17	2.59	2.58	2.53	2.58	2.58	2.55	2.56	2.61	2.53	0.098	0.135
P	Dec. 88	17	.165	.164	.165	.161	.166	.166	.166	.163	.165	0.005	0.007
	Dec. 89	17	.159	.160	.156	.156	.159	.161	.161	.159	.155*	0.006	0.008
K	Dec. 88	17	.860	.822	.826	.832	.848	.828	.769	.833	.907**	0.096	0.133
	Dec. 89	17	.765	.786	.702	.760	.769	.725	.690	.734	.830**	0.086	0.119
Ca	Dec. 88	17	.747	.767	.753	.755	.757	.756	.759	.743	.765	0.043	0.059
	Dec. 89	17	.798	.763	.807	.784	.794	.790	.770	.779	.819	0.075	0.104
Mg	Dec. 88	17	.300	.292	.297	.298	.293	.298	.324	.291*	.275**	0.030	0.042
	Dec. 89	17	.316	.324	.321	.324	.313	.324	.360	.314**	.288**	0.028	0.039
Cl	Dec. 88	17	.732	.731	.729	.727	.715	.751	.706	.737	.749	0.058	0.080
	Dec. 89	17	.723	.737	.721	.736	.710	.736	.714	.706	.762*	0.041	0.057
S	Dec. 89	17	.185	.189	.185	.184	.186	.189	.185	.189	.185	0.009	0.012

PRODUCTION

	N0	N1	N2	P0	P1	P2	K0	K1	K2	L.S.D. 5 %	L.S.D. 1 %
kg of bunches/tree											
1988	70	65	70	71	65	68	72	68	65	14.2	19.7
1989	78	71	78	79	75	75	77	75	77	19.1	26.4
Number of bunches/tree											
1988	4.2	3.9	4.3	4.3	4.0	4.2	4.4	4.0	4.0	0.70	0.97
1989	3.8	3.4	3.7	3.8	3.5	3.6	3.6	3.5	3.8	0.82	1.14
Mean bunch weights											
1988	16.7	16.5	16.3	16.7	16.3	16.4	16.5	16.9	16.1	1.09	1.50
1989	20.6	21.0	21.0	20.8	21.1	20.7	21.1	21.6	19.9	1.27	1.76

PALMIER

DATE D'EDITION : 1990/ 7/ 4

GHANA GHCP02 DF 12/89 RG17 (AN1)

NUMERO DE LA DEMANDE : 150
****

DR 11/05/90

N° DU PROBLEME :

CAMPAGNE D.F. : 90

TRAIT NPK	NB	NR	PAR	NULAB	N	P	K	CA	MG	CL	S
002	1		1	5282	2.552	0.155	0.872	0.869	0.289	0.725	0.184
010	1		3	5283	2.506	0.162	0.626	0.875	0.333	0.613	0.180
021	1		7	5284	2.529	0.161	0.760	0.802	0.321	0.752	0.176
101	1		9	5285	2.554	0.153	0.680	0.740	0.354	0.693	0.179
112	1		2	5286	2.563	0.157	0.910	0.809	0.289	0.761	0.174
120	1		5	5287	2.575	0.168	0.617	0.692	0.365	0.722	0.186
200	1		8	5288	2.496	0.155	0.587	0.771	0.38[illegible]	0.723	0.184
211	1		4	5289	2.639	0.165	0.784	0.736	0.304	0.654	0.191
222	1		6	5290	2.404	0.150	0.657	0.854	0.312	0.739	0.178
000	2		13	5291	2.536	0.157	0.921	0.585	0.394	0.747	0.174
011	2		10	5292	2.636	0.165	0.758	0.754	0.318	0.656	0.200
022	2		17	5293	2.586	0.157	0.798	0.916	0.284	0.823	0.193
102	2		12	5294	2.559	0.160	0.812	0.736	0.333	0.748	0.189
110	2		14	5295	2.551	0.159	0.794	0.754	0.381	0.780	0.191
121	2		11	5296	2.661	0.165	0.784	0.721	0.335	0.704	0.211
201	2		16	5297	2.507	0.147	0.698	0.870	0.314	0.782	0.192
212	2		18	5298	2.650	0.160	0.860	0.818	0.242	0.715	0.194
220	2		15	5299	2.685	0.174	0.638	0.793	0.365	0.766	0.202
T9				~~5300~~	~~2.702~~	~~0.162~~	~~0.941~~	~~0.754~~	~~0.285~~	~~0.698~~	~~0.200~~
001	3		21	5301	2.814	0.161	0.754	0.782	0.279	0.719	0.193
012	3		25	5302	2.546	0.154	0.773	0.806	0.298	0.798	0.184
020	3		26	5303	2.614	0.161	0.627	0.792	0.326	0.675	0.183
100	3		20	5304	2.665	0.163	0.732	0.876	0.307	0.718	0.189

PAGE N° : 2 DEMANDE N° : 150

TRAIT NPK	NB	NR	PAR	NULAB	N	P	K	CA	MG	CL	S
111	3		19	5305	2.670	0.160	0.747	0.801	0.271	0.728	0.184
122	3		24	5306	2.445	0.157	1.002	0.741	0.283	0.783	0.194
202	3		22	5307	2.490	0.149	0.787	0.824	0.262	0.768	0.175
210	3		23	5308	2.424	0.151	0.667	0.791	0.381	0.684	0.176
221	3		27	5309	2.443	0.152	0.643	0.803	0.326	0.662	0.176

****************************EXPERIENCE: GHC202 **************************

MOYENNE DE LA VARIABLE:N   pour les années: 09

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES	
N 0	2.633	2.567	2.577	2.592	100
N 1	2.593	2.593	2.563	2.583	99.66
N 2	2.500	2.570	2.510	2.527	97.47

MOYENNE BLOC 1	2.5356
MOYENNE BLOC 2	2.5989
MOYENNE BLOC 3	2.5678

	K 0	K 1	K 2	MOYENNES	
P 0	2.570	2.623	2.533	2.576	100
P 1	2.493	2.650	2.587	2.577	100.04
P 2	2.627	2.543	2.480	2.550	99.01

	N 0	N 1	N 2	MOYENNES	
K 0	2.553	2.600	2.537	2.563	100
K 1	2.660	2.627	2.530	2.606	101.65
K 2	2.563	2.523	2.513	2.533	98.83

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.223719			
BLOC	2		0.018052	0.0090	0.95	0.41
N L	1	-0.066	0.019339		2.04	0.17
N C	1	-0.048	0.003424		0.36	0.56
N G	1	-0.074	0.008313		0.88	0.38
N A	1	-0.057	0.014450		1.53	0.23
P L	1	-0.026	0.002939		0.31	0.59
P C	1	-0.028	0.001157		0.12	0.73
P G	1	-0.024	0.000896		0.09	0.76
P A	1	-0.027	0.003200		0.34	0.58
K L	1	-0.030	0.004050		0.43	0.53
K C	1	-0.114	0.019646		2.08	0.17
K G	1	0.012	0.000224		0.02	0.85
K A	1	-0.072	0.023472		2.48	0.13
N L*P L	1	0.033	0.003333		0.35	0.57
N L*K L	1	-0.017	0.000833		0.09	0.76
P L*K L	1	-0.055	0.009075		0.96	0.36
ERREUR	15		0.141869	0.0095		

	D.S.5%	D.S.1%
EFFETS L.A	0.0977	0.1351
EFFETS C.G	0.1692	0.2340
INT LL	0.1197	0.1655

MOYENNE GENERALE 2.5674

C.V. 3.79

**************************EXPERIENCE: GHCP02 **************************
MOYENNE DE LA VARIABLE:P pour les annees: 89

TABLEAUX CROISES

		P 0	P 1	P 2	MOYENNES			
N	0	0.158	0.160	0.160	0.159	100	MOYENNE BLOC 1	0.1584
N	1	0.159	0.159	0.163	0.160	100.63	MOYENNE BLOC 2	0.1604
N	2	0.150	0.159	0.159	0.156	97.91	MOYENNE BLOC 3	0.1564

		K 0	K 1	K 2	MOYENNES	
P	0	0.158	0.154	0.155	0.156	100
P	1	0.157	0.163	0.157	0.159	102.36
P	2	0.168	0.159	0.155	0.161	103.21

		N 0	N 1	N 2	MOYENNES	
K	0	0.160	0.163	0.160	0.161	100
K	1	0.162	0.159	0.155	0.159	98.55
K	2	0.155	0.158	0.153	0.155 *	96.48

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.000993			
BLOC	2		0.000072	0.0000	1.17	0.34
N L	1	-0.003	0.000050		1.62	0.22
N C	1	-0.005	0.000043		1.39	0.26
N G	1	-0.002	0.000008		0.27	0.62
N A	1	-0.004	0.000085		2.74	0.12
P L	1	0.005	0.000113		3.65	0.07 presque S
P C	1	-0.002	0.000008		0.27	0.62
P G	1	0.009	0.000113		3.66	0.07 presque S
P A	1	0.001	0.000008		0.26	0.62
K L	1	-0.006	0.000144		4.69 *	0.04
K C	1	-0.001	0.000002		0.05	0.81
K G	1	-0.008	0.000096		3.12	0.09
K A	1	-0.003	0.000050		1.62	0.22
N L*P L	1	0.003	0.000030		0.98	0.36
N L*K L	1	-0.001	0.000004		0.13	0.72
P L*K L	1	-0.005	0.000065		2.12	0.16
ERREUR	15		0.000462	0.0000		

	D.S.5%	D.S.1%
EFFETS L.A	0.0056	0.0077
EFFETS C,G	0.0097	0.0134
INT LL	0.0068	0.0094

MOYENNE GENERALE 0.1584
C.V. 3.50

************************EXPERIENCE: GHCP02 ************************ [illegible]
MOYENNE DE LA VARIABLE:K pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.849	0.719	0.728	0.765	100	MOYENNE BLOC 1	0.7214
N 1	0.741	0.817	0.801	0.786	102.74	MOYENNE BLOC 2	0.7848
N 2	0.691	0.770	0.646	0.702	91.75	MOYENNE BLOC 3	0.7480

	K 0	K 1	K 2	MOYENNES	
P 0	0.747	0.711	0.824	0.760	100
P 1	0.696	0.763	0.848	0.769	101.11
P 2	0.627	0.729	0.819	0.725	95.37

	N 0	N 1	N 2	MOYENNES	
K 0	0.725	0.714	0.631	0.690	100
K 1	0.757	0.737	0.708	0.734	106.43
K 2	0.814	0.908	0.768	0.830	120.33

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.279981			
BLOC	2		0.018207	0.0091	1.25	0.32
N L	1	-0.063	0.017924		2.46	0.13
N C	1	-0.105	0.016573		2.28	0.15
N G	1	-0.042	0.002660		0.37	0.56
N A	1	-0.084	0.031836		4.37	0.05
P L	1	-0.035	0.005583		0.77	0.40
P C	1	-0.052	0.004073		0.56	0.47
P G	1	-0.027	0.001076		0.15	0.71
P A	1	-0.044	0.008581		1.18	0.30
K L	1	0.140	0.088480		12.15 **	0.00
K C	1	0.052	0.003987		0.55	0.48
K G	1	0.185	0.051091		7.01 *	0.02
K A	1	0.096	0.041376		5.68 *	0.03
N L*P L	1	0.038	0.004332		0.59	0.46
N L*K L	1	0.024	0.001704		0.23	0.64
P L*K L	1	0.057	0.009861		1.35	0.26
ERREUR	15		0.109257	0.0073		

	D.S.5%	D.S.1%
EFFETS L.A	0.0857	0.1186
EFFETS C.G	0.1485	0.2054
INT LL	0.1050	0.1452

MOYENNE GENERALE 0.7514
C.V. 11.36

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.745	0.812	0.837	0.798	100	MOYENNE BLOC 1	0.7942
N 1	0.784	0.708	0.718	0.763	95.67	MOYENNE BLOC 2	0.7719
N 2	0.822	0.782	0.817	0.807	101.10	MOYENNE BLOC 3	0.8018

	K 0	K 1	K 2	MOYENNES	
P 0	0.744	0.797	0.810	0.784	100
P 1	0.807	0.764	0.811	0.794	101.29
P 2	0.759	0.775	0.837	0.790	100.86

	N 0	N 1	N 2	MOYENNES	
K 0	0.751	0.774	0.785	0.770	100
K 1	0.779	0.754	0.803	0.779	101.15
K 2	0.864	0.762	0.832	0.819	106.41

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.120366			
BLOC	2		0.004348	0.0022	0.39	0.69
N L	1	0.009	0.000347		0.06	0.79
N C	1	0.078	0.009100		1.64	0.22
N G	1	-0.026	0.000997		0.18	0.68
N A	1	0.043	0.008450		1.52	0.23
P L	1	0.007	0.000207		0.04	0.83
P C	1	-0.013	0.000271		0.05	0.81
P G	1	0.017	0.000428		0.08	0.78
P A	1	-0.003	0.000050		0.01	0.89
K L	1	0.049	0.010952		1.97	0.18
K C	1	0.032	0.001494		0.27	0.62
K G	1	0.058	0.005085		0.92	0.37
K A	1	0.040	0.007361		1.33	0.27
N L*P L	1	-0.048	0.006960		1.25	0.28
N L*K L	1	-0.033	0.003267		0.59	0.46
P L*K L	1	0.006	0.000114		0.02	0.86
ERREUR	15		0.083307	0.0056		

	D.S.5%	D.S.1%
EFFETS L.A	0.0749	0.1035
EFFETS C,G	0.1297	0.1793
INT LL	0.0917	0.1268

MOYENNE GENERALE 0.7893
C.V. 9.44

**************************EXPERIENCE: GHCP02 ************************** [illegible]

MOYENNE DE LA VARIABLE:MG pour les annees: 87

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.321	0.316	0.310	0.316	100	MOYENNE BLOC 1	0.3281
N 1	0.331	0.314	0.328	0.324	102.67	MOYENNE BLOC 2	0.3296
N 2	0.321	0.309	0.334	0.321	101.76	MOYENNE BLOC 3	0.3037

	K 0	K 1	K 2	MOYENNES	
P 0	0.362	0.316	0.295	0.324	100
P 1	0.365	0.298	0.276	0.313	96.54
P 2	0.352	0.327	0.293	0.324	99.97

	N 0	N 1	N 2	MOYENNES	
K 0	0.351	0.351	0.377	0.360	100
K 1	0.306	0.320	0.315	0.314 **	87.15
K 2	0.290	0.302	0.272	0.288 **	80.05

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.042241			
BLOC	2		0.003810	0.0019	2.48	0.12
N L	1	0.006	0.000139		0.18	0.68
N C	1	-0.011	0.000193		0.25	0.63
N G	1	0.014	0.000294		0.38	0.55
N A	1	-0.003	0.000038		0.05	0.81
P L	1	-0.000	0.000000		0.00	0.94
P C	1	0.022	0.000748		0.97	0.36
P G	1	-0.011	0.000193		0.25	0.63
P A	1	0.011	0.000556		0.72	0.42
K L	1	-0.072	0.023184		30.13 **	0.00
K C	1	0.021	0.000641		0.83	0.39
K G	1	-0.118	0.020886		27.14 **	0.00
K A	1	-0.026	0.002939		3.82	0.07
N L*P L	1	0.012	0.000432		0.56	0.47
N L*K L	1	-0.022	0.001496		1.94	0.18
P L*K L	1	0.004	0.000056		0.07	0.78
ERREUR	15		0.011542	0.0008		

	D.S.5%	D.S.1%
EFFETS L,A	0.0279	0.0385
EFFETS C,G	0.0483	0.0667
INT LL	0.0341	0.0472

MOYENNE GENERALE 0.3204
C.V. 8.66

*************************EXPERIENCE: GHCP02 *************************   13-08-1990   [illegible]

MOYENNE DE LA VARIABLE:CL   pour les annees: 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.730	0.689	0.750	0.723	100	MOYENNE BLOC 1	0.7091 -
N 1	0.720	0.756	0.736	0.737	101.98	MOYENNE BLOC 2	0.7468 -
N 2	0.758	0.684	0.722	0.721	99.77	MOYENNE BLOC 3	0.7261 -

	K 0	K 1	K 2	MOYENNES	
P 0	0.729	0.731	0.747	0.736	100
P 1	0.692	0.679	0.758	0.710	96.47
P 2	0.721	0.706	0.782	0.736	100.05

	N 0	N 1	N 2	MOYENNES	
K 0	0.678	0.740	0.724	0.714	100
K 1	0.709	0.708	0.699	0.706	98.79
K 2	0.782	0.764	0.741	0.762 *	106.72

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.063356			
BLOC	2		0.006405	0.0032	1.90	0.18
N L	1	-0.002	0.000012		0.01	0.89
N C	1	-0.030	0.001380		0.82	0.39
N G	1	0.013	0.000241		0.14	0.71
N A	1	-0.016	0.001152		0.68	0.43
P L	1	0.000	0.000000		0.00	0.93
P C	1	0.052	0.004108		2.44	0.14
P G	1	-0.026	0.000988		0.59	0.46
P A	1	0.026	0.003121		1.85	0.19
K L	1	0.048	0.010368		6.15 *	0.02
K C	1	0.065	0.006403		3.80	0.07
K G	1	0.039	0.002321		1.38	0.26
K A	1	0.057	0.014450		8.57 *	0.01
N L*P L	1	-0.028	0.002269		1.34	0.26
N L*K L	1	-0.044	0.005720		3.39	0.08
P L*K L	1	0.021	0.001387		0.82	0.39
ERREUR	15		0.025303	0.0017		

	D.S.5%	D.S.1%
EFFETS L,A	0.0413	0.0571
EFFETS C,G	0.0715	0.0988
INT LL	0.0505	0.0699

MOYENNE GENERALE 0.7273
C.V. 5.65

****************************EXPERIENCE: GHCP02 ****************************

MOYENNE DE LA VARIABLE:S pour les années 89

TABLEAUX CROISES

	P 0	P 1	P 2	MOYENNES			
N 0	0.184	0.188	0.184	0.185	100	MOYENNE BLOC 1	0.1813
N 1	0.186	0.183	0.197	0.189	101.80	MOYENNE BLOC 2	0.1940
N 2	0.184	0.187	0.185	0.185	100.06	MOYENNE BLOC 3	0.1838

	K 0	K 1	K 2	MOYENNES	
P 0	0.182	0.188	0.183	0.184	100
P 1	0.182	0.192	0.184	0.186	100.90
P 2	0.190	0.188	0.188	0.189	102.41

	N 0	N 1	N 2	MOYENNES	
K 0	0.179	0.189	0.187	0.185	100
K 1	0.190	0.191	0.186	0.189	102.22
K 2	0.187	0.186	0.182	0.185	100.00

SOURCE DE VARIATION	D.D.L	EFFETS MOYENS	SOMME DES CARRES	CARRE MOYEN	F CALCULE	PROBABILITE DE F
TOTALE	26		0.002286			
BLOC	2		0.000813	0.0004	5.62 *	0.01
N L	1	0.000	0.000000		0.00	0.93
N C	1	-0.007	0.000064		0.89	0.37
N G	1	0.003	0.000018		0.25	0.63
N A	1	-0.003	0.000047		0.65	0.44
P L	1	0.004	0.000089		1.23	0.29
P C	1	0.001	0.000002		0.03	0.85
P G	1	0.006	0.000056		0.77	0.40
P A	1	0.003	0.000035		0.48	0.51
K L	1	0.000	0.000000		0.00	1.00
K C	1	-0.008	0.000101		1.40	0.25
K G	1	0.004	0.000025		0.35	0.57
K A	1	-0.004	0.000076		1.05	0.32
N L*P L	1	0.001	0.000001		0.02	0.86
N L*K L	1	-0.007	0.000127		1.75	0.20
P L*K L	1	-0.001	0.000004		0.06	0.80
ERREUR	15		0.001085	0.0001		

	D.S.5%	D.S.1%
EFFETS L,A	0.0085	0.0118
EFFETS C,G	0.0148	0.0205
INT LL	0.0105	0.0145

MOYENNE GENERALE 0.1864
C.V. 4.56

ANNEXE I.3.

				N	P	K	CA	MG	CL	DFU	MOP	TSP	ASHES
A 10	85 ~~82~~	12/88	17	2.350	0.152	0.652	1.107	0.278	0.791	8/89		500	
A 10	~~82~~									10/89	2500		
A 10	~~82~~	11/89	17	2.530	0.154	0.776	0.858	0.291	0.761				
A 12	85 ~~82~~	12/88	9	3.060	0.182	1.168	0.625	0.309	0.701	8/89		500	
A 12	~~82~~									10/89	2500		
A 12	~~82~~	11/89	17	3.020	0.168	0.927	0.899	0.296	0.847				
A 14	85 ~~82~~	12/88	17	2.780	0.167	0.940	0.951	0.287	0.860	8/89		500	
A 14	~~82~~									9/89	2500		
A 14	~~82~~	11/89	17	2.830	0.160	0.649	0.843	0.269	0.674				
AN 03	77	12/87	17	2.520	0.159	0.808	0.773	0.265	0.619				
AN 03	77	12/88	17	2.500	0.152	0.822	0.656	0.274	0.672	8/89	1500		
AN 03	77	11/89	17	2.390	0.147	0.788	0.674	0.319	0.689				
AS 06	85 ~~82~~	12/88	17	2.670	0.167	0.627	1.028	0.366	0.724	8/89		500	
AS 06	~~82~~									9/89	2500		
AS 06	~~82~~	11/89	17	2.780	0.156	0.568	1.100	0.335	0.749				
AS 15	85 ~~82~~	12/88	17	2.720	0.160	0.833	1.047	0.273	0.779	7/89	750	750	
AS 15	~~82~~	11/89	17	2.750	0.152	0.742	0.955	0.299	0.643				
BN 02	77	12/87	17	2.670	0.164	1.008	0.821	0.214	0.588				
BN 02	77	12/88	17	2.460	0.158	0.860	0.738	0.263	0.764	9/89	1500		
BN 02	77	11/89	17	2.630	0.155	0.764	0.713	0.304	0.847				
BN 04	77	12/87	17	2.620	0.160	1.046	0.873	0.257	0.688				
BN 04	77	12/88	17	2.550	0.159	0.857	0.712	0.280	0.716	9/89	1500		
BN 04	77	11/89	17	2.320	0.148	0.759	0.737	0.321	0.744				
BN 06	77	12/87	17	2.350	0.153	0.806	0.796	0.311	0.695				
BN 06	77	12/88	17	2.410	0.161	0.831	0.766	0.336	0.775	9/89	1500		
BN 06	77	11/89	17	2.460	0.157	0.715	0.819	0.325	0.738				
BS 01	78	12/87	17	2.450	0.153	0.834	0.796	0.258	0.610				
BS 01	78	12/88	17	2.700	0.162	0.902	0.757	0.220	0.616				
BS 01	78	11/89	17	2.620	0.156	0.825	0.792	0.276	0.751	11/89	2000	500	
BS 07	82	12/88	17	2.750	0.166	0.859	0.989	0.313	0.874	9/89	2500	1000	
BS 07	82	11/89	17	2.950	0.161	0.835	0.924	0.287	0.685				
BS 11	82	12/87	17	2.650	0.158	0.698	0.957	0.334	0.693				
BS 11	82	12/88	17	2.660	0.152	0.642	0.870	0.281	0.726	6/89	500		
BS 11	82									8/89		500	
BS 11	82	11/89	17	2.630	0.146	0.639	0.805	0.289	0.826				
CN 03	78	12/87	17	2.490	0.162	0.803	0.859	0.288	0.649				
CN 03	78	12/88	17	2.580	0.164	0.798	0.767	0.272	0.678	8/89		500	
CN 03	78									10/89	2000		
CN 03	78	11/89	17	2.730	0.164	0.868	0.677	0.272	0.724				

	DPL	DDP	RGP	N	P	K	CA	MG	CL	DFU	MOP	TSP	ASHES
CN 05	78	12/87	17	2.600	0.165	0.878	0.897	0.253	0.634				
CN 05	78	12/88	17	2.550	0.155	0.769	0.807	0.281	0.676	8/89		500	
CN 05	78									10/89	2000		
CN 05	78	11/89	17	2.700	0.164	0.756	0.832	0.251	0.685				
CN 09	78	12/88	17	2.550	0.160	0.759	0.790	0.255	0.666	9/89		500	
CN 09	78	11/89	17	2.620	0.162	0.797	0.794	0.285	0.768	11/89	2000		
CS 02	78	12/87	17	2.660	0.165	0.705×	0.962	0.297	0.647				
CS 02	78	12/88	17	2.570	0.159	0.723	0.769	0.297	0.809	8/89		500	
CS 02	78									10/89	2000		
CS 02	78	11/89	17	2.570	0.156	0.602	0.761	0.250	0.731				
CS 07	78	12/87	17	2.870	0.165	0.992	0.860	0.255	0.494				
CS 07	78	12/88	17	2.660	0.159	0.898	0.723	0.254	0.649	8/89		500	
CS 07	78									9/89	2000		
CS 07	78	11/89	17	2.640	0.161	0.817	0.704	0.289	0.750				
DN 03	79	12/87	17	2.630	0.159	0.879	0.870	0.223	0.612				
DN 03	79	12/88	17	2.490	0.148	0.892	0.715	0.255	0.733	9/89	1500	1000	
DN 03	79	11/89	17	2.610	0.153	0.862	0.691	0.292	0.804				
DN 12	79	12/87	17	2.850	0.164	1.047	0.931	0.212	0.546				
DN 12	79	12/88	17	2.760	0.156	0.899	0.894	0.236	0.623	9/89	1500		
DN 12	79	11/89	17	2.700	0.155	0.924	0.840	0.267	0.712				
DN 14	79	12/87	17	2.590	0.155	0.735	0.895	0.288	0.599	9/89	1500		
DN 14	79	11/89	17	2.760	0.163	0.908	0.721	0.267	0.653				
DS 01	79	12/87	17	2.650	0.158	0.825	0.815	0.211	0.469				
DS 01	79	12/88	17	2.610	0.156	0.912	0.748	0.260	0.609	9/89	1500	1000	
DS 01	79	11/89	17	2.610	0.157	0.874	0.747	0.281	0.763				
DS 03	79	12/87	17	2.720	0.159	0.914	0.870	0.297	0.653				
DS 03	79	12/88	17	2.480	0.158	0.661	0.822	0.380	0.636	7/89		1000	
DS 03	79									9/89	1500		
DS 03	79	11/89	17	2.610	0.153	0.935	0.735	0.315	0.716				
EN 06	79	12/87	17	2.810	0.163	0.876	0.944	0.272	0.668				
EN 06	79	12/88	17	2.890	0.161	0.873	0.885	0.265	0.694	6/89	1500	1000	
EN 06	79	11/89	17	2.740	0.160	0.863	0.952	0.293	0.744				
EN 16	81	12/87	17	2.770	0.164	0.877	0.931	0.266	0.578				
EN 16	81	12/88	17	2.720	0.157	0.909	0.878	0.248	0.632	7/89	1500		
EN 16	81									9/89		500	
EN 16	81	11/89	17	2.740	0.151	0.877	0.940	0.292	0.601				
ES 01	80	12/88	17	2.610	0.160	0.762	0.883	0.278	0.713	8/89	2000×	750	QUANTITE NON PRECISEE (03/89)
ES 01	80	11/89	17	2.990	0.169	0.992	0.799	0.303	0.705				
FN 10	80	12/87	17	2.580	0.157	0.677	0.941	0.401	0.634				
FN 10	80	12/88	17	2.460	0.153	0.646	0.793	0.410	0.652	6/89	2000		
FN 10	80	11/89	17	2.640	0.156	0.792	0.770	0.380	0.687				

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	[illegible]	[illegible]	[illegible]	N	P	K	CA	MG	CL	DFU	MOF	TSP	ASHES		
FN 15	80	12/87	17	2.660	0.166	0.891	0.759	0.320	0.638						
FN 15	80	12/88	17	2.630	0.158	0.845	0.779	0.321	0.728	8/89		750			
FN 15	80									9/89	2000				
FN 15	80	11/89	17	2.740	0.159	0.856	0.831	0.361	0.779						
GN 19	81	12/87	17	2.600	0.158	0.843	0.784	0.351	0.692						
GN 19	81	12/88	17	2.960	0.183	0.839	0.810	0.378	0.741	7/89	1500				
GN 19	81	11/89	17	2.670	0.151	0.577	1.089	0.457	0.846						
HN 16	80	12/87	17	2.540	0.160	0.798	0.832	0.315	0.529						
HN 16	80	12/88	17	2.590	0.150	0.837	0.753	0.331	0.678	8/89		750			
HN 16	80									10/89	2000				
HN 16	80	11/89	17	2.640	0.155	0.815	0.882	0.334	0.772						
HN 18	80	12/87	17	2.760	0.163	1.299	1.031	0.307	0.609						
HN 18	80	12/88	17	2.760	0.160	0.852	0.929	0.350	0.606	10/89	2000				
HN 18	80	11/89	17	2.680	0.149	0.828	0.880	0.331	0.570						
HN 20	80	12/87	17	2.620	0.161	1.148	0.993	0.273	0.524						
HN 20	80	12/88	17	2.730	0.160	1.026	0.962	0.251	0.564	10/89	500	750			
HN 20	80	11/89	17	2.790	0.161	1.023	1.073	0.308	0.619						
HN 24	81	12/87	17	2.650	0.164	0.854	0.939	0.330	0.727						
HN 24	81	12/88	17	2.770	0.163	0.725	0.967	0.302	0.626	9/89	1500				
HN 24	81	11/89	17	2.870	0.163	0.857	0.850	0.353	0.751						
IN 15	80	12/87	17	2.470	0.149	0.821	0.803	0.342	0.664						
IN 15	80	12/88	17	2.510	0.150	0.719	0.861	0.320	0.664	8/89		750			
IN 15	80									9/89	2000				
IN 15	80	11/89	17	2.630	0.150	0.826	0.766	0.364	0.781						
IN 19	81	12/88	17	2.510	0.151	0.738	0.853	0.292	0.668	7/89	1500				
IN 19	81									8/89		500			
IN 19	81	11/89	17	2.660	0.155	0.700	0.962	0.321	0.762						
-------- Moyennes --------															
Moy.	77	12/87	17	2.540	0.159	0.917	0.816	0.262	0.647						
Moy.	77	12/88	17	2.480	0.157	0.842	0.718	0.288	0.732						
Moy.	77	11/89	17	2.450	0.152	0.757	0.736	0.317	0.754						
Moy.	78	12/87	17	2.614	0.162	0.842	0.875	0.270	0.607						
Moy.	78	12/88	17	2.602	0.160	0.808	0.769	0.263	0.682						
Moy.	78	11/89	17	2.647	0.161	0.777	0.760	0.271	0.735						
Moy.	79	12/87	17	2.708	0.160	0.879	0.887	0.251	0.591						
Moy.	79	12/88	17	2.646	0.156	0.847	0.813	0.279	0.659						
Moy.	79	11/89	17	2.672	0.157	0.894	0.781	0.286	0.732						
Moy.	80	12/87	17	2.605	0.159	0.939	0.893	0.326	0.600						
Moy.	80	12/88	17	2.613	0.156	0.812	0.851	0.323	0.658						
Moy.	80	11/89	17	2.730	0.157	0.876	0.857	0.340	0.702						
Moy.	81	12/87	17	2.673	0.162	0.858	0.885	0.316	0.666						
Moy.	81	12/88	17	2.740	0.164	0.803	0.877	0.305	0.667						
Moy.	81	11/89	17	2.735	0.155	0.753	0.960	0.356	0.740						
Moy.	82	12/87	17	2.650	0.158	0.698	0.957	0.334	0.693						
Moy.	82	12/88	9	3.060	0.182	1.168	0.625	0.309	0.701						
Moy.	82	12/88	17	~~2.655~~	~~0.161~~	~~0.759~~	~~0.999~~	~~0.300~~	~~0.792~~	2,705	0,159	0,751	0,930	0,297	0,800
Moy.	82	11/89	17	2.784	0.157	0.734	0.912	0.295	0.741	2,790	0,153	0,737	0,865	0,288	0,755
	85	88		2,630	0,162	0,763	1,033	0,301	0,789						
	85	/89		2,782	0,158	0,732	0,931	0,298	0,734						

	[illegible]	DDP	RGP	N	P	K	CA	MG	CL	DFU	MOP	TSP	ASHES
AS 08	85 ~~82~~	12/88	17	2.870	0.165	0.909	0.932	0.282	0.816	6/89	750		
AS 08	~~82~~									8/89		750	
AS 08	~~82~~	11/89	17	3.070	0.167	0.966	0.817	0.276	0.668				
AS 10	85 ~~82~~	12/88	17	2.940	0.168	0.834	1.042	0.294	0.812	7/89	750		
AS 10	~~82~~									8/89		750	
AS 10	~~82~~	11/89	17	2.810	0.156	0.821	1.037	0.281	0.714				
AS 13	85 ~~82~~	12/88	17	2.800	0.167	0.864	1.102	0.263	0.714	7/89	750	750	
AS 13	~~82~~	11/89	17	2.960	0.160	0.996	0.912	0.288	0.671				
BS 04	78	12/87	17	2.690	0.159	1.044	0.820	0.237	0.591				
BS 04	78	12/88	17	2.660	0.161	0.997	0.675	0.241	0.608	6/89	750		
BS 04	78	11/89	17	2.730	0.164	1.016	0.681	0.272	0.679				
BS 06	78									6/89	750		
BS 06	78									8/89		500	
BS 06	78	11/89	17	2.450	0.146	0.651	0.909	0.307	0.733				
BS 09	82	12/87	17	2.730	0.163	1.005	0.873	0.334	0.765				
BS 09	82	12/88	17	2.860	0.169	1.026	0.938	0.287	0.671	6/89	500		
BS 09	82									9/89		500	
BS 09	82	11/89	17	3.020	0.162	0.997	0.842	0.282	0.642				
CN 01	78	12/87	17	2.620	0.158	0.958	0.781	0.228	0.569				
CN 01	78	12/88	17	2.720	0.159	0.946	0.814	0.255	0.647	7/89	750		
CN 01	78									8/89		500	
CN 01	78	11/89	17	2.830	0.150	1.160	0.877	0.320	0.627				
CS 04	78	12/87	17	2.850	0.163	0.939	0.851	0.295	0.554				
CS 04	78	12/88	17	2.650	0.157	0.976	0.785	0.281	0.709	7/89	750		
CS 04	78									8/89		500	
CS 04	78	11/89	17	2.690	0.159	0.948	0.771	0.263	0.682				
CS 08	78	12/88	17	2.620	0.159	0.783*	0.882	0.241	0.627	6/89	750		
CS 08	78									8/89		500	
CS 08	78	11/89	17	2.700	0.162	0.885	0.729	0.264	0.688				
DN 10	79	12/87	17	2.770	0.164	0.921	0.934	0.297	0.567				
DN 10	79	12/88	17	2.600	0.152	0.887	0.880	0.282	0.708	9/89	500		
DN 10	79									10/89		1000	
DN 10	79	11/89	17	2.740	0.160	0.801	0.874	0.292	0.739				
DS 04	79	12/87	17	2.870	0.171	1.126	0.940	0.281	0.581				
DS 04	79	12/88	17	2.670	0.159	1.015	0.851	0.302	0.731	7/89		1000	
DS 04	79									9/89	500		
DS 04	79	11/89	17	2.860	0.163	1.077	0.848	0.310	0.730				
EN 03	79	12/87	17	2.680	0.159	0.897	0.870	0.316	0.581				
EN 03	79	12/88	17	2.770	0.161	0.875	0.827	0.315	0.645	6/89	500	1000	
EN 03	79	11/89	17	2.860	0.161	0.863	0.844	0.315	0.665				
EN 07	79	12/88	17	2.690	0.159	0.868	0.907	0.241	0.645	6/89	500	1000	
EN 07	79	11/89	17	2.900	0.159	0.888	0.845	0.279	0.671				

	[illegible]	[illegible]	[illegible]	N	P	K	CA	MG	CL	DFU	MOP	TSP	ASHES
EN 09	79	12/87	17	2.870	0.169	0.928	1.082	0.255	0.652				
EN 09	79	12/88	17	2.720	0.155	0.917	0.817	0.236	0.608	6/89	500	1000	
EN 09	79	11/89	17	2.680	0.150	1.047	0.773	0.266	0.775				
FN 04	79	12/87	17	2.590	0.161	0.898	0.983	0.284	0.691				
FN 04	79	12/88	17	2.500	0.146	0.992	1.014	0.271	0.637	7/89	500	1000	
FN 04	79	11/89	17	2.550	0.150	0.892	1.103	0.259	0.617				
FN 05	79	12/87	17	2.630	0.153	0.905	0.961	0.272	0.679				
FN 05	79	12/88	17	2.780	0.159	1.024	0.911	0.263	0.632	6/89	500		
FN 05	79									7/89		1000	
FN 05	79	11/89	17	2.600	0.156	0.901	1.050	0.281	0.594				
FN 12	80	12/87	17	2.660	0.160	0.818	0.859	0.327	0.509				
FN 12	80	12/88	17	2.800	0.166	0.927	0.827	0.320	0.612	8/89	500		
FN 12	80	11/89	17	2.930	0.166	1.062	0.835	0.326	0.668				
FN 14	80	12/87	17	2.650	0.165	1.059	0.962	0.350	0.522				
FN 14	80	12/88	17	2.900	0.163	0.944	0.850	0.327	0.584	10/89	500		
FN 14	80	11/89	17	2.910	0.160	0.941	0.928	0.335	0.602				
FN 17	81	12/87	17	2.820	0.165	0.888	0.943	0.225	0.525				
FN 17	81	12/88	17	2.690	0.158	0.869	0.921	0.227	0.538	6/89	750		
FN 17	81									8/89		1000	
FN 17	81	11/89	17	2.760	0.153	0.915	0.940	0.213	0.497				
FN 19	81	12/87	17	2.590	0.162	0.951	0.837	0.301	0.431				
FN 19	81	12/88	17	2.670	0.154	0.759	0.959	0.244	0.441	6/89	750		
FN 19	81									8/89		1000	
FN 19	81	11/89	17	2.660	0.155	0.766	1.008	0.309	0.559				
GN 09	.80	12/87	17	2.600	0.167	0.862	0.893	0.278	0.509				
GN 09	80	12/88	17	2.720	0.164	0.879	0.898	0.234	0.545	7/89	500		
GN 09	80									8/89		750	
GN 09	80	11/89	17	2.690	0.161	0.978	0.797	0.248	0.621				
GN 12	80	12/87	17	2.760	0.166	0.983	1.144	0.278	0.545				
GN 12	80	12/88	17	2.730	0.154	1.008	0.907	0.270	0.655	7/89	500	750	
GN 12	80	11/89	17	2.920	0.162	1.025	0.945	0.304	0.616				
GN 13	80	12/87	17	2.660	0.170	0.938	1.189	0.274	0.537				
GN 13	80	12/88	17	2.710	0.167	1.041	0.923	0.257	0.648	7/89	500	750	
GN 13	80	11/89	17	2.890	0.163	1.035	0.830	0.224	0.531				
GN 22	81	12/87	17	2.850	0.165	1.157	1.114	0.249	0.681				
GN 22	81	12/88	17	2.710	0.157	1.042	1.075	0.217	0.605	6/89	750		
GN 22	81									9/89		1000	
GN 22	81	11/89	17	2.820	0.158	1.204	0.919	0.253	0.596				
GN 23	81	12/87	17	2.790	0.164	0.862	1.129	0.266	0.624				
GN 23	81	12/88	17	2.730	0.161	0.770	1.027	0.261	0.613	6/89	750		
GN 23	81									9/89		1000	
GN 23	81	11/89	17	2.940	0.164	0.845	1.026	0.251	0.587				

				N	P	K	CA	MG	CL	DFU	MOP	TSP	ASHES		
HN 12	80	12/87	17	2.710	0.166	0.993	1.029	0.327	0.599						
HN 12	80	12/88	17	2.670	0.161	0.962	0.952	0.328	0.625	7/89	500				
HN 12	80	11/89	17	2.700	0.153	0.981	0.933	0.322	0.660						
HN 25	81	12/88	17	2.690	0.155	0.935	0.973	0.303	0.692	6/89	750				
HN 25	81									8/89		1000			
HN 25	81	11/89	17	2.840	0.160	0.967	0.929	0.321	0.753						
IN 17	81									6/89	750				
IN 17	81									8/89		1000			
IN 17	81	11/89	17	3.030	0.163	1.057	0.988	0.273	0.593						
IN 22	81	12/88	17	2.580	0.149	0.848	1.005	0.350	0.650	8/89		1000			
IN 22	81									10/89	750				
IN 22	81	11/89	17	2.830	0.161	0.985	0.903	0.347	0.697						
-------- Moyennes --------															
Moy.	78	12/87	17	2.720	0.160	0.980	0.817	0.253	0.571						
Moy.	78	12/88	17	2.663	0.159	0.925	0.789	0.254	0.648						
Moy.	78	11/89	17	2.680	0.156	0.932	0.793	0.285	0.682						
Moy.	79	12/87	17	2.735	0.163	0.946	0.962	0.284	0.625						
Moy.	79	12/88	17	2.676	0.156	0.940	0.887	0.273	0.658						
Moy.	79	11/89	17	2.741	0.157	0.924	0.905	0.286	0.684						
Moy.	80	12/87	17	2.673	0.166	0.942	1.013	0.306	0.537						
Moy.	80	12/88	17	2.755	0.163	0.960	0.893	0.289	0.611						
Moy.	80	11/89	17	2.840	0.161	1.004	0.878	0.293	0.616						
Moy.	81	12/87	17	2.763	0.164	0.964	1.006	0.260	0.565						
Moy.	81	12/88	17	2.678	0.156	0.871	0.993	0.267	0.590						
Moy.	81	11/89	17	2.840	0.159	0.963	0.959	0.281	0.612						
Moy.	82	12/87	17	2.730	0.163	1.005	0.873	0.334	0.765						
Moy.	82	12/88	17	~~2.867~~	~~0.167~~	0~~.908~~	1~~.003~~	~~0.281~~	0~~.753~~	2.860	0,164	1.026	0,938	0,287	0,671
Moy.	82	11/89	17	~~2.965~~	~~0.161~~	0~~.945~~	0~~.902~~	0.~~282~~	0~~.674~~	3.020	0,162	0,997	0,842	0,282	0,642
	85	88		2.870	0 167	0.869	1.025	0.280	0.781						
		89		2.947	0.161	0,928	0.922	0.282	0.684						

ANNEXE I.3.

PALMIER

DATE D'EDITION : 1990/ 4/13

GHANA GOPDC NUCLEUS NOV 89

NUMERO DE LA DEMANDE : 90
****

DR 15/03/90

N° CONVENTION :

CAMPAGNE D.F. 90

LOCALITE	MV	COD	BLOC	RG	DP	NULAB	N	P	K	CA	MG	CL
AN3			TEMANG		77	3246	2.390	0.147	0.788	0.674	0.319	0.689
BN2			TEMANG		77	3247	2.631	0.155	0.764	0.713	0.304	0.847
BN4			TEMANG		77	3248	2.323	0.148	0.759	0.737	0.321	0.744
BN6			ODA		77	3249	2.457	0.157	0.715	0.819	0.325	0.738
BS1			TEMANG		78	3250	2.618	0.156	0.825	0.792	0.276	0.751
BS4			NZIMA		78	3251	2.725	0.164	1.016	0.681	0.272	0.679
BS6			NZIMA		78	3252	2.452	0.146	0.651	0.909	0.307	0.733
CN1			NZIMA		78	3253	2.827	0.150	1.160	0.877	0.320	0.627
CN3			TEMANG		78	3254	2.733	0.164	0.868	0.677	0.272	0.724
CN5			TEMANG		78	3255	2.699	0.164	0.756	0.832	0.251	0.685
CN9			TEMANG		78	3256	2.618	0.162	0.797	0.794	0.285	0.768
CS2			TEMANG		78	3257	2.573	0.156	0.602	0.761	0.250	0.731
CS4			NZIMA		78	3258	2.689	0.159	0.948	0.771	0.263	0.682
CS7			TEMANG		78	3259	2.643	0.161	0.817	0.704	0.289	0.750
	T9					3260	2.695	0.162	0.968	0.767	0.272	0.607
CS8			NZIMA		78	3261	2.700	0.162	0.885	0.729	0.264	0.688
DN3			TEMANG		79	3262	2.610	0.153	0.862	0.691	0.292	0.804
DN10			NZIMA		79	3263	2.735	0.160	0.801	0.874	0.292	0.739
DN12			TEMANG		79	3264	2.698	0.155	0.924	0.840	0.267	0.712
DN14			TEMANG		79	3265	2.763	0.163	0.908	0.721	0.267	0.653
DS1			KOKOFU		79	3266	2.607	0.157	0.874	0.747	0.281	0.763
DS3			TEMANG		79	3267	2.614	0.153	0.935	0.735	0.315	0.716
DS4			NZIMA		79	3268	2.857	0.163	1.077	0.848	0.310	0.730
EN3			NZIMA		79	3269	2.856	0.161	0.863	0.844	0.315	0.665

LOCALITE	MV COD	BLOC	RG DP	NULAB	N	P	K	CA	MG	CL
EN6		KOKOFU	79	3270	2.737	0.160	0.863	0.952	0.293	0.744
EN7		NZIMA	79	3271	2.901	0.159	0.888	0.845	0.279	0.671
EN9		NZIMA	79	3272	2.678	0.150	1.047	0.773	0.266	0.775
FN4		BEKWAI	79	3273	2.547	0.150	0.892	1.103	0.259	0.617
FN5		NZIMA	79	3274	2.601	0.156	0.901	1.050	0.281	0.594
ES1		TEMANG	80	3275	2.986	0.169	0.992	0.799	0.303	0.705
FN10		TEMANG	80	3276	2.636	0.156	0.792	0.770	0.380	0.687
FN12		BEKWAI	80	3277	2.926	0.166	1.062	0.835	0.326	0.668
FN14		NZIMA	80	3278	2.908	0.160	0.941	0.928	0.335	0.602
FN15		TEMANG	80	3279	2.739	0.159	0.856	0.831	0.361	0.779
	T9			3280	2.663	0.165	0.966	0.748	0.281	0.607
GN9		BEKWAI	80	3281	2.687	0.161	0.978	0.797	0.248	0.621
GN12		NZIMA	80	3282	2.915	0.162	1.025	0.945	0.304	0.616
GN13		NZIMA	80	3283	2.888	0.163	1.035	0.830	0.224	0.531
HN12		NZIMA	80	3284	2.695	0.153	0.981	0.933	0.322	0.660
HN16		ODA	80	3285	2.635	0.155	0.815	0.882	0.334	0.772
HN18		TEMANG	80	3286	2.684	0.149	0.828	0.880	0.331	0.570
IN15		ODA	80	3287	2.633	0.150	0.826	0.766	0.364	0.781
HN20		TEMANG	80	3288	2.788	0.161	1.023	1.073	0.308	0.619
EN16		KOKOFU	81	3289	2.736	0.151	0.877	0.940	0.292	0.601
FN17		NZIMA	81	3290	2.758	0.153	0.915	0.940	0.213	0.497
FN19		NZIMA	81	3291	2.660	0.155	0.766	1.008	0.309	0.559
GN19		ODA	81	3292	2.669	0.151	0.577	1.089	0.457	0.846
GN22		NZIMA	81	3293	2.819	0.158	1.204	0.919	0.253	0.596
GN23		NZIMA	81	3294	2.936	0.164	0.845	1.026	0.251	0.587
HN24		TEMANG	81	3295	2.874	0.163	0.857	0.850	0.353	0.751
IN17		NZIMA	81	3296	3.030	0.163	1.057	0.988	0.273	0.593

LOCALITE	MV COD	BLOC	RG	DP	NULAB	N	P	K	CA	MG	CL
IN19		TEMANG		81	3297	2.664	0.155	0.700	0.962	0.321	0.762
IN22		NZIMA		81	3298	2.827	0.161	0.985	0.903	0.347	0.697
HN25		NZIMA		81	3299	2.840	0.160	0.967	0.929	0.321	0.753
	T9				3300	2.670	0.162	0.964	0.753	0.283	0.610
AS6		TEMANG 85		82	3301	2.775	0.156	0.568	1.100	0.335	0.749
AS8		NZIMA 85		82	3302	3.065	0.167	0.966	0.817	0.276	0.668
AS10		NZIMA 85		82	3303	2.811	0.156	0.821	1.037	0.281	0.714
AS13		NZIMA 85		82	3304	2.958	0.160	0.996	0.912	0.288	0.671
AS15		TEMANG 85		82	3305	2.749	0.152	0.742	0.955	0.299	0.643
BS7		TEMANG		82	3306	2.953	0.161	0.835	0.924	0.287	0.685
BS9		NZIMA		82	3307	3.016	0.162	0.997	0.842	0.282	0.642
BS11		TEMANG		82	3308	2.628	0.146	0.639	0.805	0.289	0.826
A10		TEMANG 85		82	3309	2.531	0.154	0.776	0.858	0.291	0.761
A12		TEMANG 85		82	3310	3.015	0.168	0.927	0.899	0.296	0.847
A14		TEMANG 85		82	3311	2.823	0.160	0.649	0.843	0.269	0.674

PALMIER DATE D'EDITION : 1990/ 5/ 4 **ANNEXE I.4.**

NUMERO DE LA DEMANDE : 103
****

GHANA GOPDC SMH OG NOV 89

DR 30-03-90

N° CONVENTION :

CAMPAGNE D.F. 90

LOCALITE	MV	COD	BLOC	RG	DP	NULAB	N	P	K	CA	MG	CL
SMH		NB	SMH 3	17	78	3834	2.740	0.154	0.959	0.918	0.243	0.534
SMH		TKO	SMH 6	17	78	3835	2.439	0.143	0.766	0.848	0.278	0.751
SMH		NB	30	17	78	3836	2.707	0.152	0.886	0.844	0.257	0.682
SMH		TKO	19	17	78	3837	2.774	0.155	0.973	0.807	0.258	0.681
SMH		TKO	27	17	78	3838	2.485	0.142	0.709	0.853	0.325	0.713
SMH		NB	129	17	79	3839	2.867	0.152	0.896	0.851	0.309	0.672
	T9					3840	2.631	0.155	0.896	0.761	0.284	0.611
SMH		TKO	133	17	79	3841	2.128	0.131	0.761	0.775	0.286	0.688
SMH		NB	142	17	79	3842	2.791	0.152	0.929	1.080	0.233	0.591
SMH		TKO	144	17	79	3843	2.860	0.156	0.899	0.939	0.267	0.601
SMH		TKO	159	17	79	3844	2.602	0.144	0.867	0.856	0.288	0.695
SMH		TKO	163	17	79	3845	2.312	0.136	0.819	0.895	0.328	0.749
SMH		TKO	150	17	79	3846	2.716	0.141	0.890	0.835	0.256	0.690
SMH		NB	173	17	80	3847	2.707	0.144	0.816	1.241	0.338	0.620
SMH		TKO	168	17	80	3848	2.761	0.157	0.805	1.068	0.303	0.645
SMH		TKO	319	17	80	3849	2.877	0.157	0.904	0.909	0.253	0.572
SMH		NB	71	17	81	3850	2.765	0.147	0.781	1.048	0.270	0.586
SMH		NB	111	17	81	3851	2.739	0.155	0.855	1.089	0.304	0.635
SMH		TKO	316	17	81	3852	2.767	0.156	0.845	0.949	0.309	0.669
SMH		TKO	50	17	81	3853	2.915	0.159	0.733	1.059	0.236	0.649
SMH		NB	320	17	81	3854	2.768	0.159	0.841	1.077	0.240	0.625
SMH		NB	37	17	81	3855	2.794	0.159	0.771	0.930	0.336	0.709
SMH		NB	187	17	81	3856	2.786	0.159	0.911	1.062	0.290	0.602
SMH		TKO	41	17	81	3857	2.681	0.153	0.724	0.851	0.365	0.733

LOCALITE	MV	COD	BLOC	RG	DP	NULAB	N	P	K	CA	MG	CL
SMH		TKO	193	17	81	3858	2.835	0.156	0.775	0.951	0.312	0.713
SMH		TKO	83B	17	82	3859	2.857	0.158	0.778	1.006	0.294	0.691
	T9					3860	2.702	0.162	0.939	0.773	0.285	0.609
SMH		TKO	281B	17	82	3861	2.626	0.146	0.620	1.022	0.288	0.642
SMH		NB	279B	17	82	3862	2.625	0.151	0.743	1.172	0.273	0.534
SMH		NB	SMH 200B	17	82	3863	2.820	0.155	0.900	0.898	0.304	0.645
SMH/OG		NB	AF022	17	79	3864	2.661	0.151	0.986	0.907	0.288	0.527
SMH/OG		TKO	AF041	17	80	3865	2.615	0.149	0.711	0.818	0.307	0.663
? SMH/OG		TKO NB	AF112	17	82	3866	2.715	0.155	1.089	0.888	0.250	0.231
SMH/OG		TKO	AF93	17	81	3867	2.439	0.146	0.831	0.860	0.266	0.654
? SMH/OG		~~TKO~~ NB	AF89	17	81	3868	2.537	0.152	0.997	0.766	0.326	0.510
SMH/OG		NB	OT02	17	79	3869	2.597	0.152	0.832	0.813	0.299	0.594
SMH/OG		NB	AB50	17	80	3870	2.481	0.143	0.827	0.749	0.401	0.354
SMH/OG		TKO	AB010	17	79	3871	2.313	0.142	0.655	0.677	0.333	0.599
SMH/OG		TKO	AB45	17	80	3872	2.603	0.154	0.870	0.821	0.378	0.387
SMH/OG		TKO	AB120	17	82	3873	2.095	0.134	0.629	0.849	0.412	0.602
OG		TKO	NAB047	09	86	3874	3.006	0.176	1.065	0.732	0.328	0.446
OG		TKO	NAB057	09	86	3875	3.038	0.174	1.056	0.758	0.345	0.657
OG		TKO	OT014	09	86	3876	2.878	0.164	1.199	0.743	0.319	0.558
OG		TKO	AS021	09	86	3877	2.804	0.164	1.062	0.773	0.368	0.679
OG	TKO	~~NB~~	OT015	09	86	3878	2.907	0.170	0.764	0.755	0.432	0.707
OG		NB	OT036	09	86	3879	3.059	0.167	1.284	0.765	0.305	0.593
	T9					3880	2.688	0.162	0.929	0.772	0.294	0.612
OG		TKO	AK003	09	86	3881	2.918	0.163	0.720	0.845	0.399	0.687
OG		TKO	AK047	09	86	3882	2.896	0.162	0.899	0.757	0.408	0.650
OG		TKO.	AK064	09	86	3883	2.773	0.161	1.030	0.637	0.323	0.716
OG		TKO	OT035	09	86	3884	2.790	0.171	0.809	0.809	0.417	0.743

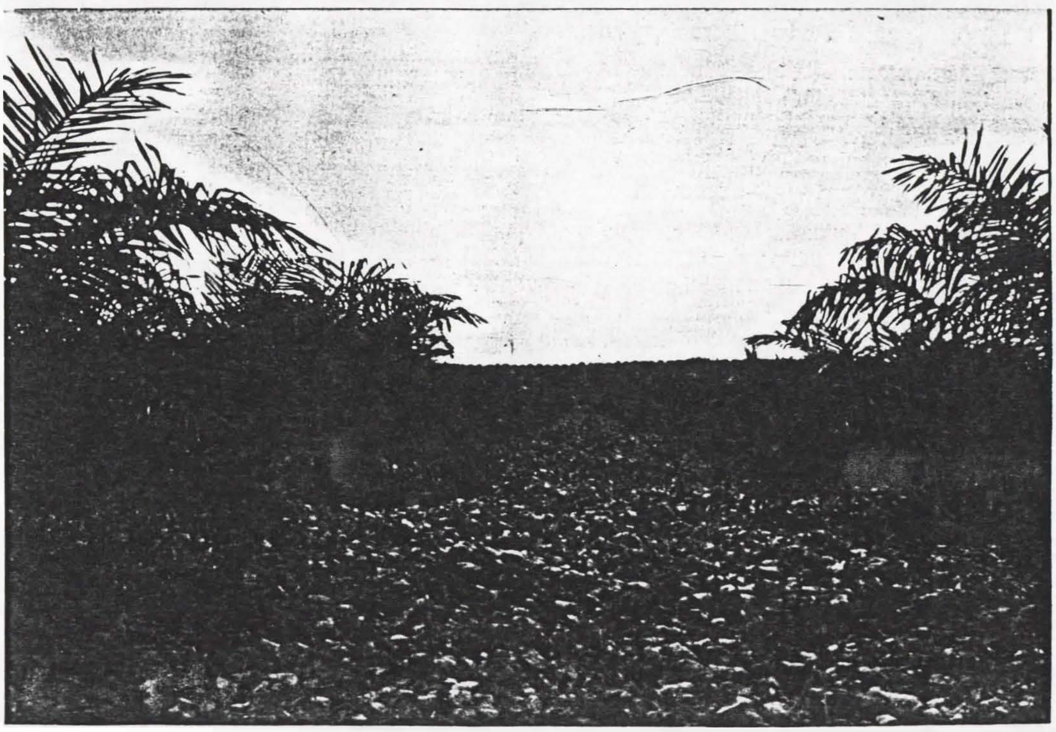
PAGE N° : 3 DEMANDE N° : 103

LOCALITE	MV	COD	BLOC	RG	DP	NULAB	N	P	K	CA	MG	CL
OG		TKO	OT053	09	86	3885	2.954	0.175	1.021	0.725	0.296	0.577
OG		TKO	AB045	09	86	3886	3.023	0.169	0.884	0.751	0.395	0.659
OG		TKO	AB039	09	86	3887	2.996	0.172	0.952	0.725	0.380	0.630
OG		TKO	AS019	09	86	3888	2.987	0.173	0.915	0.669	0.363	0.672

Annexes II

Clones

ANNEXE II.1.
CLONES
PLANTING 1988



ANNEXE II.1.

CLONES

PLANTING 1988

ANNEXE II.2.

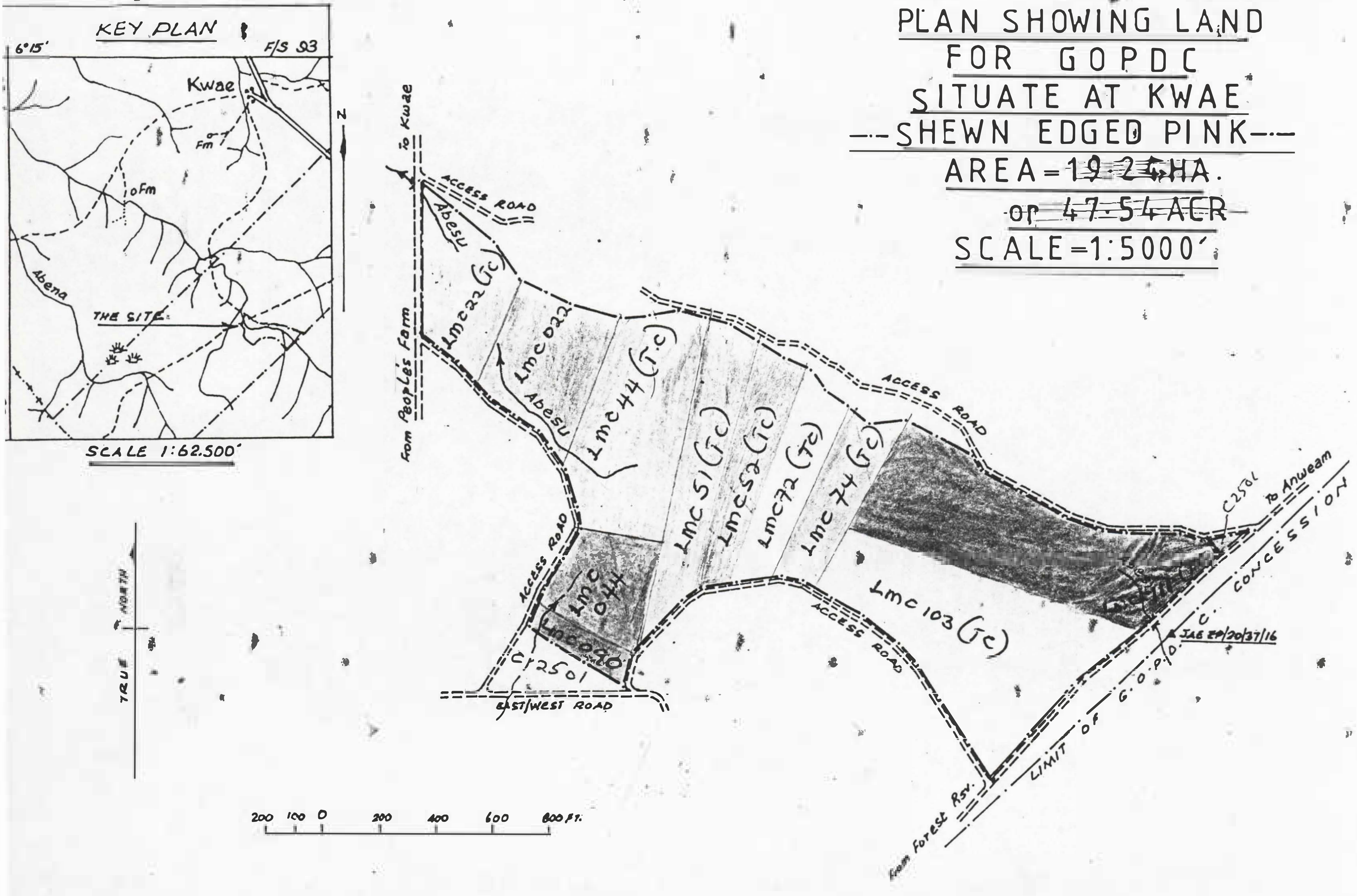
PLAN SHOWING LAND FOR GOPDC SITUATE AT KWAE

—·-SHEWN EDGED PINK—·—

AREA=19.24HA.

or 47.54ACR

SCALE=1:5000'



ANNEXE II-2

PEDIGREE & CHARACTERISTICS OF IRHO CLONES SUPPLIED TO GOPDC

CLONE N°	PARENTAL CROSSES						ORTETS				
	PARENTS	PLANTING YEAR	FFB T/ha/yr	% Ø/Bi	Palm Oil T/ha/yr	Vertical growth cm/yr	FFB T/ha/yr	% Ø/Bi	Palm Oil T/ha/yr	% Cr	Vertical growth cm/yr
LMC 022	D115D x L2T	62	18.8	22.1	4.16	43	19.2	27.0	5.18	125	46
LMC 044	L10T x D17D	62	18.0	21.8	3.93	45	19.7	23.3	4.60	117	47
LMC 051	L2T x D8D	59	16.5	21.6	3.56	42	17.3	27.0	4.67	131	50
LMC 052	D3D x L2T	62	16.7	21.9	3.65	42	21.1	23.0	4.85	133	44
LMC 072	D759D x L311P	68	16.7	20.8	3.47	48	19.4	23.5	4.56	131	46
LMC 074	L452T x UR425-4	68	18.2	22.5	4.09	50	21.7	23.7	5.15	126	54
LMC 090	L10T x D8D	60	15.7	23.3	3.66	39	21.8	27.2	5.92	162	41
LMC 103	L10T x D118D	62	17.0	22.5	3.83	43	18.0	25.6	4.61	121	47
LMC 111	L10T x D28D	64	15.8	22.2	3.51	45	18.8	25.2	4.74	135	45

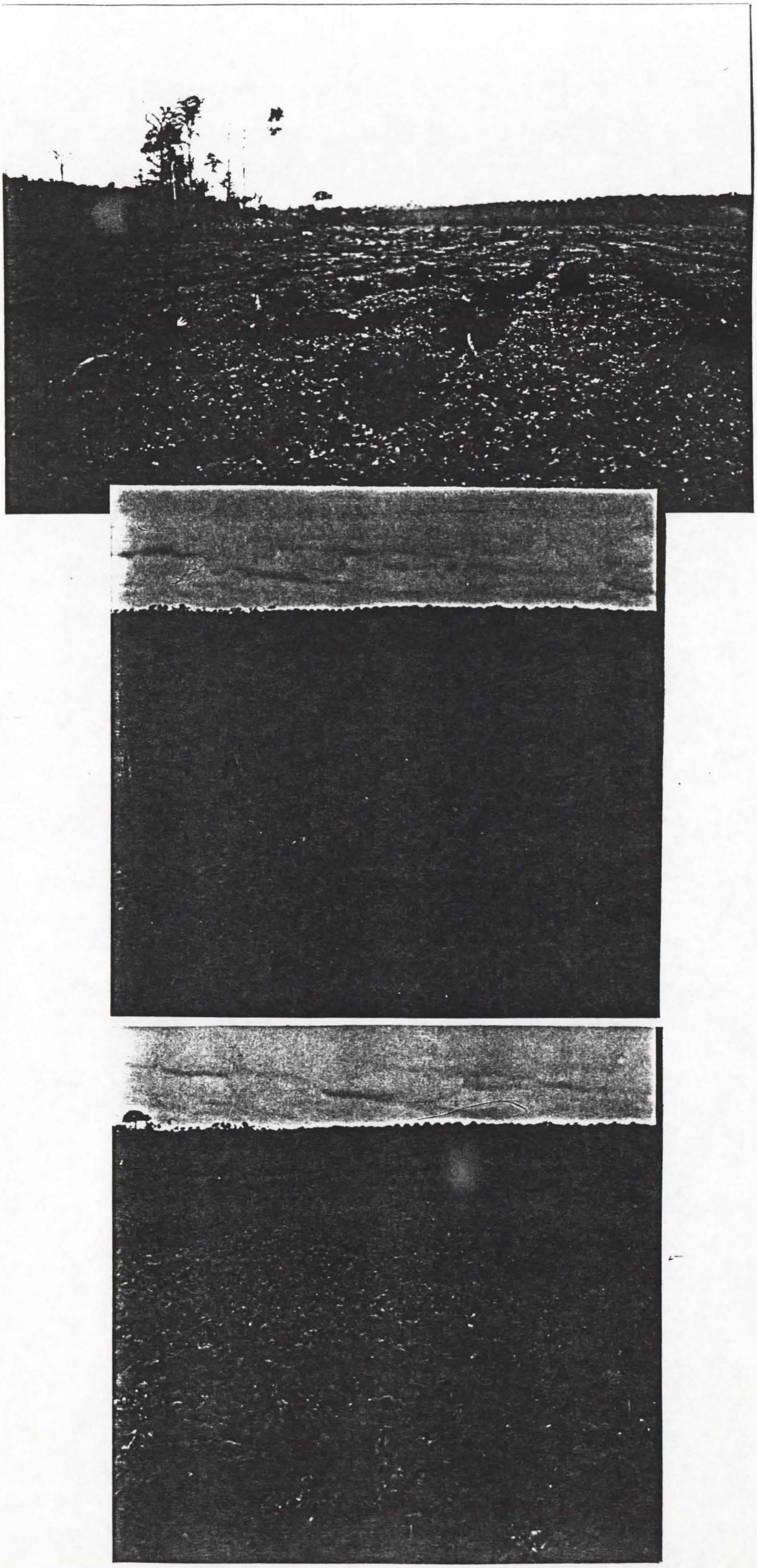
O/Bi = Commercial extraction rate

% Cr = % of parental cross

ANNEXE II.3.

CLONES

PLANTING 1990



ANNEXE III

OPRI TRIAL

ANNEXE III
OPRI
TRIAL